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No. 1

THE ROENTGENOLOGIC ASPECTS OF

ACTINOMYCOSIS OF THE LUNGS*

B. R. Kirklin, M.D., AND HANS W. HEFKE, M.D.

ROCHESTER, MINN.

T is often difficult clinically to distinguish actinomycosis from other chronic diseases of the thorax, and many cases are recorded in which the disease was wrongly diagnosed for months or years, and finally necropsy revealed its nature. It seems to be most difficult to rule out chronic empyema and tuberculosis. Fistulas, especially when multiple, or hard infiltration of the wall of the thorax in connection with pulmonary symptoms, should be suspected of being of actinomycotic origin; the secretion of such fistulas, the pus from empyematous cavities with marked infiltration of the thoracic wall, and the sputum, should be examined for the organism. Unfortunately, it is not always easy to demonstrate actinomyces and repeated examinations may be necessary. With these considerable difficulties in diagnosis it is easily understood that even in the earlier period of roentgen diagnosis roentgenoscopy and roentgenograms were used to help in the distinction from other diseases.

A review of the literature was undertaken because there seemed to be so few complete data pertaining to this subject. All cases reviewed were proved to be actinomycosis by demonstration of the specific organism during life or at necropsy. Otten, in 1910, reported a case of actinomycotic invasion of the thorax which was represented by bilateral large irregular mediastinal shadows and pulmonary in-

filtration. A similar case was mentioned by Weber in 1911; both hilums were infiltrated by dense masses which radiated into the lungs giving the appearance of a carcinomatous infiltration. Karewski reviewed the subject in 1914 from a surgical standpoint and pointed out that actinomycotic lesions usually produce dense shadows, often quite circumscribed. He stated that the roentgenologic manifestations were not pathognomonic and often were unreliable. Staub-Oetiker noted 5 cases which had been clinically diagnosed as tuberculosis, and he attributed only a negative value to the roentgen examination inasmuch as it merely excluded a tuberculous lesion. He noted in 2 of his 5 cases either destruction or periosteal thickening of one or more ribs which he had never seen in tuberculosis. Wessler and Jaches described 3 cases of actinomycosis. They stated that the roentgenologic data are not characteristic but represent indurative pleuropneumonia such as may be found in other forms of pulmonary suppuration. However, such an appearance with clinical signs of infiltration of the wall of the thorax should lead to the diagnosis of actinomycosis. Bigland and Sergeant, in 1923, observed a case of actinomycosis in which there was a dense shadow in the lower left part of the thorax with fluid in the pleural and pericardial cavities. The difficulty of distinction between chronic tuberculosis and actinomycosis was emphasized by Besser who found in t case parenchymatous involvement of the right lung and hilum with an abscess, pleuritic adhesions, and



Fig. 1, Case 11. Dense mediastinal infiltration extending into right lung.

areas of destruction in two ribs. That the lung may be invaded secondarily from abdominal actinomycosis was suggested by Cottle and Satterlee, who reported a case with invasion of the right lung and elevation of the diaphragm. Lord found it difficult to distinguish from a malignant condition. Perforation of the wall of the thorax, however, occurs in about 80 per cent of the cases. Torek's case was first diagnosed roentgenologically as a tumor, then as advanced tuberculosis; he did not consider the roentgen-ray examination to be of any help in diagnosis. Two types of actinomycosis of the lungs as seen roentgenologically are recognized by Turner: first, involvement of the hilum extending into the lung along the bronchi and causing extensive fibrosis, and second, parenchymatous involvement in the form of an abscess. Pleural involvement may be seen often. His case presented characteristics of both types. Sanford and Voelker re-

ported in 1925 that in about 14 per cent of all the cases of actinomycosis reviewed by them, lesions of the thorax were present. In Vinson and Sutherland's case, reported in 1926, marked density was seen in the lower left side of the thorax, associated with bronchial fistula. Chronic fibroid tuberculosis, diffuse pulmonary neoplasm, empyema, or chronic pneumonia with pleurisy must be considered from a differential standpoint, according to Gittings and Thorpe, who saw a dense shadow over the entire left side of the thorax in the case of a child, aged five years. A solitary, fairly well circumscribed shadow in the lung, which looked like an abscess, was the picture presented in Lüdin's case. Christison and Warwick, in 1027, were of the opinion that the roentgen picture of the disease must be variable. They named four types of pulmonary involvement: bronchitic, pneumonic, pleuropneumonic, and metastatic, the existence of the last condition being questionable. Their case showed areas of consolidation scattered throughout the lungs with dense pleuritic adhesions. In one of Preston's cases the right upper lobe was invaded with dilated bronchi, as demonstrated by injection of lipiodol. In the other case the same condition was seen in the lower portion of the left lung. A combination of pneumonic infiltration in the left side of the thorax with fluid and partial destruction of three ribs allowed Halpern and Levinson to make the diagnosis of actinomycosis of the thorax. In van den Wildenberg's case there was definite mediastinal involvement, probably by continuity from infected cervical lymph nodes. He also mentioned a case of Kissling's with a dense shadow at the hilum suggesting mediastinal tumor. Elevation of the diaphragm, pleural adhesions and some fluid were the only changes noted in the thorax in a case of Geymüller, described in 1928. Johnson and Kernan described dense consolidation of the right lower and middle lobes suggesting an abscess with atelectasis; this was

relieved by the removal of a fibrinous plug blocking the right bronchus. Injection of lipiodol revealed a large abscess in the larity to tuberculosis. Krause found circumscribed pleural involvement with bronchiectasis, enlargement of the bron-



Fig. 2, Case iv. Pleuritic involvement with some fluid at base of left lung.

Fig. 3, Case vii. Thickened pleura on right with some fluid. Invasion of right middle and lower lobes and periostitis of third, fourth and fifth ribs anteriorly.

right lower lobe. A case described by Assmann presented a dense, uniform atypical shadow of the right upper lobe. According to Schinz, actinomycosis of the thorax is almost never recognizable by roentgen examination alone as its picture is not characteristic. In his own case there was enlargement of the hilum with increased density in the surrounding parts of the lung. Cabot, in 1929, described the roentgen appearance of a case of actinomycosis as being similar to that of pneumonoconiosis, the process being extensive, diffuse and fibrotic, with pleural involvement on the right side. Tuberculosis was diagnosed roentgenologically in Schweizer's case; increased density was noted over the lower left lobe of the lung, and an exaggeration of the shadow of the hilum on the right. Extensive cloudiness throughout the upper part of the right lung with a small amount of fluid and adhesions was noted by Chambers, and he emphasized the simi-

chial lymph nodes and perihilar infiltration in I case which he reported in 1929. Naegeli reported a case with pleuropulmonary involvement in the left lower lobe of the lung. In Teschendorf's case there was a large, well defined, diffuse shadow in the upper part of the right lung. Markó described 3 cases in 1929, I with encapsulated empyema and thick pleural adhesions, another with fluid in the base of the left lung and pericardial effusion, and a third with multiple abscesses in the upper lobe of the left lung and increased perihilar density. He recognized 3 types of pulmonary involvement: a primary type, caused by aspiration of material containing the actinomycotic organism which involves the parenchyma by way of the bronchi, a secondary type which invades the lungs by extension from the neck or esophagus, and a metastatic type which invades the lung by the blood or lymph passages, and which is

rare. Actinomycotic bronchitis does not produce any roentgenologic manifestation, according to Markó. The broncho-

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Briefly summarized, the clinical and roentgenologic manifestations in the 14 cases were as follows:

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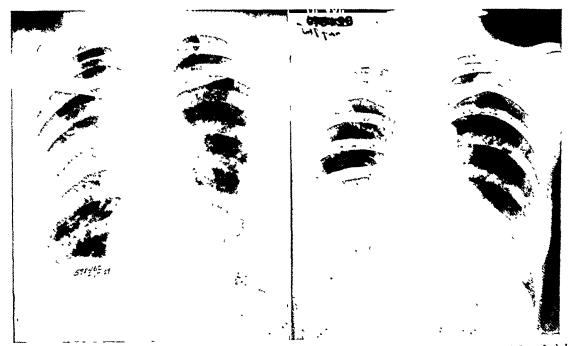


Fig. 4, Case x. Actinomycosis of middle and upper lobes of right lung with involvement of seventh and eighth ribs posteriorly.

Fig. 5, Case XI. Actinomycosis of lower lobe of right lung with thickening of hilum.

pneumonic form usually invades only one lobe, the lower, and especially its subpleural portions; cavities may occur which cannot be distinguished from abscess of the lung. As characteristic must be considered the tendency to marked connective tissue proliferation, dense adhesions and dense pleural thickening, often accompanied by retraction of the entire diseased lung and by fluid. Involvement of the ribs is considered to be a rare complication.

We are able to report the roentgenologic manifestations in 14 cases of actinomycosis affecting the lungs and pleura. In all of them, the ray fungus was demonstrated in the discharge from fistulas of the thoracic wall or in the contents of an empyema cavity in the sputum. In certain cases repeated examinations and careful study were required to discover the organism, and it is evident that actinomycosis cannot be excluded by a single examination.

Case I. A woman, aged thirty-nines, year had multiple abscesses of the wall of the thorax, following mastitis eleven years before. She had had an abdominal abscess three years before; pus from the thoracic sinuses contained actinomyces. Roentgenograms disclosed the presence of destruction of the right second rib and upper portion of the sternum on the right side. The pleura on the left side was thickened, and the heart was markedly displaced to the left; coarse infiltration with abscess in the left upper lobe was noted.

Case II. A man, aged thirty-three years, had had a discharging sternal sinus for six months. Sulphur bodies were found in pus from the sinus. Roentgenograms disclosed fairly dense mediastinal infiltration, enlarged hilums with dense infiltration radiating into the right lung, particularly toward the upper lobe, and a small area of destruction in the sternum (Fig. 1).

Case III. A man, aged fifty-five years, had multiple sinuses in the lower right thoracic and abdominal walls for eight years following operation for an abdominal abscess. The ray fungus was found in pus from the sinuses. Roentgenograms disclosed elevation of the months before examination, followed by a persistent sinus, right-sided empyema, and thoracic fistula. The ray fundus was found

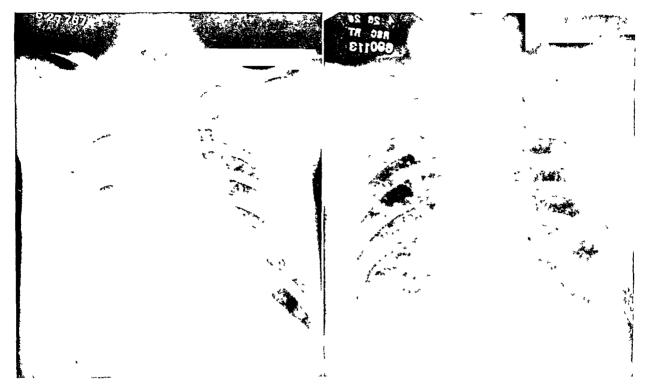


Fig. 6, Case XII. Actinomycosis of lower lobe of right lung with thickened pleura and small amount of fluid.

Fig. 7, Case XIV. Actinomycosis of lower lobe of right lung with involvement of pleura, interlobar pleurisy and small amount of fluid.

right side of the diaphragm to the level of the fourth interspace anteriorly, a thickened pleura, and enlargement of the shadow of the hilum on the right side, with dense infiltration radiating into the lung.

Case IV. A woman, aged twenty-two years, had had draining sinuses in the left breast and wall of the thorax for one year. Sulphur bodies were demonstrated in pus from the sinuses. Roentgenograms disclosed a thickened pleura and a small amount of fluid at the base of the left lung (Fig. 2).

Case v. A man, aged forty-five years, had had thoracic sinuses following an operation for empyema four years before examination. A smear was positive for actinomyces. Roentgenograms disclosed elevation of the diaphragm to the fifth rib anteriorly, thick pleural bands and adhesions, a rather dense hilar shadow with infiltration toward the lung and periosteal thickening of the eighth and ninth ribs posteriorly.

Case vi. A woman, aged twenty-nine years, had had an appendiceal abscess six

in the sputum. Roentgenograms disclosed marked elevation of the right side of the diaphragm, thickened pleura, and dense pleural adhesions. The right hilum was definitely enlarged and the right upper lobe was infiltrated.

Case vii. A man, aged forty-seven years, had had pneumonia followed by empyema five years before examination. Thoracotomy was followed by multiple abscesses of the wall of the thorax. Actinomycotic organisms were demonstrated in pus from the abscesses. Roentgenograms disclosed thickening of the pleura on the right with some fluid, uniform, rather dense infiltration of the right middle and lower lobes, and definite periostitis of the third, fourth and fifth ribs anteriorly (Fig. 3).

Case viii. A man, aged forty-six years, had had acute empyema seven months before examination. Surgical drainage was followed by multiple sinuses. The specific organism was found in pus from the wall of the thorax. Roentgenograms disclosed consolidation of the lower portion of the right middle lobe with considerable fibrosis and dense bands of

adhesions, increased hilar density, questionable abscess in the middle lobe, and partial destruction of the fifth to eighth ribs anteriorly.

Case IX. A man, aged twenty-three years, had had an appendiceal abscess eight months before examination followed by a subdiaphragmatic abscess and pulmonary symptoms. The sputum, and the pus from the abdominal sinus, contained actinomyces. Roentgenograms disclosed marked elevation of the right side of the diaphragm and thick bands of pleural adhesions.

CASE X. A man, aged twenty-four years, had had abscess of the liver two years before examination. Surgical drainage was followed by multiple sinuses and the pus from the sinuses contained actinomyces. Roentgenograms disclosed infiltration of the right middle and upper lobes, increased shadow in the hilum, and destruction of the seventh and eight ribs on the right side posteriorly (Fig. 4).

Case xi. A woman, aged thirty-six years, had had an abdominal abscess one and a half years before examination. Multiple sinuses and pulmonary symptoms developed after the operation. The sputum and the pus from the thoracic and abdominal sinuses contained actinomyces. Roentgenograms disclosed dense infiltration of the right lower lobe with thickening of the hilum (Fig. 5).

CASE XII. A youth, aged eighteen years, had had an abdominal abscess which had been drained surgically eight months previously. Multiple sinuses and pulmonary symptoms ensued. Actinomycotic organisms were demonstrable in fluid from the thorax and in pus from an abdominal sinus. Roentgenograms disclosed a thickened pleura, fluid at the base of the right lung, and infiltration of the right lower lobe (Fig. 6).

Case XIII. A woman, aged thirty-eight years, had had an abdominal abscess four months before examination which was followed by a sinus and pulmonary symptoms. A smear from the abdominal sinus revealed actinomyces. Roentgenograms disclosed elevation of the diaphragm on the right side, and patchy infiltration in the right lower lobe of the lung.

Case xiv. A man, aged fifty-seven years, had had an abdominal abscess one and a half

years before examination, which was followed by a subdiaphragmatic abscess, empyema, and fistulas. Pus from an abdominal sinus contained actinomyces. Roentgenograms disclosed pleuritic thickening of the base of the right lung and peripherally to the level of the fifth rib anteriorly, and interlobar pleurisy on the right side (Fig. 7).

COMMENT

A review of our cases seems to indicate that pulmonary and pleural invasion often follows abdominal actinomycosis. In 8 of the 14 cases there was a definite history of abdominal abscesses, or of draining sinuses from an appendiceal abscess, or of abscess of the liver, preceding the thoracic symptoms. Three patients had had acute empyema, in 1 case preceded by pneumonia. Thoracotomy in all these cases was followed by persistent sinuses. Such formation of fistulas was also common after abdominal operations. In 2 other cases the first symptom to be complained of was mastitis followed by or in combination with abscesses of the wall of the thorax but apparently without pulmonary symptoms. It is probable that infection took place first through the skin of the breast and thorax. In I case only was it probable that the thorax was involved by direct extension from diseased lymph nodes of the neck. It seems that primary infection of the lung is somewhat rare. Only 3 of the 14 cases with the history of empyema can be considered as belonging to this group. In 2 cases the process appeared to have originated primarily in the wall of the thorax; in the other 9 there was a definite history of primary involvement of the abdominal organs (8 cases), or cervical lymph nodes (1 case). A draining sinus from an abdominal operation in combination with gradually developing thoracic symptoms should make one suspicious of actinomycosis, particularly if there is infiltration of the wall of the thorax with or without sinuses.

Men are more often affected than women, in this series 10 of 14. The age of the

patients was from eighteen to fifty-seven vears. The shortest time between the first appearance of symptoms and the definite diagnosis made at the clinic was four months, and the longest time fifteen years. In many of the cases a diagnosis had been made elsewhere of chronic empyema with fistula. There were 3 cases in which the disease apparently had been present but not diagnosed for many years; in I case five years, in I eleven years and in I fifteen years. None of the patients apparently had been treated specifically for actinomycosis, that is, by potassium iodide and irradiation. These data illustrate the difficulty of establishing the diagnosis of actinomycosis of the thorax, yet only an early diagnosis gives the patient a chance for recovery. This has been shown by Designations in his review of patients treated in The Mayo Clinic by radiotherapy.

With respect to the site of the principal roentgenologic manifestation the cases of this series may be classified in four groups: (1) pulmonary, (2) pleuropulmonary, (3) pleural, and (4) thoracic. Eight of the 14 cases belong in group 2, 1 belongs in group 1, 4 belong in group 3, and 5 belong in group 4; in these, roentgenologically demonstrable lesions of the bony wall of the thorax were found, in each instance combined with pleural or pulmonary lesions. Except in I case only, pulmonary involvement led to definite pleural changes. The primary focus in the thorax was apparently in the mediastinal and hilar region. Thickened, rather dense strands radiated from these structures into the lung, particularly the right upper lobe. One might attribute this picture to invasion of the peribronchial lymphatics as described by the pathologists.

The pleuropulmonary variety was most common. When pulmonary and pleural lesions are demonstrable the mode of invasion cannot be determined definitely; it may have been primary in the lung or secondary to abdominal disease. A high diaphragm might suggest abdominal disease, but this is not a reliable index.

In the 8 cases of this group, the right side of the thorax was involved in 7, and the left side in 1 case only. The upper lobes were invaded in 2 cases, in 4 cases the lower and middle lobes were invaded, and in 2 there was infiltration into the lung radiating from the hilum and not definitely confined to any one lobe.

The roentgenogram in actinomycosis of the lung is not uniform, as might be expected from the observations of pathologists. In certain cases they find carnification of entire lobes with fibrosis and many small abscesses, and the roentgenologist may find dense infiltration of one or two entire lobes. The abscesses are probably not large enough to be seen in roentgenograms; in our series they could not be distinguished. Another variety described by pathologists is a patchy involvement of parts of the lungs with or without the formation of abscess; this was seen in 3 of our cases. Definite breaking down into cavities is sometimes seen. Unlike other abscesses, those caused by actinomycosis may be subpleural and usually other areas of infiltration which are not broken down may be demonstrable. Occasionally invasion of the lung apparently radiating from the hilum into the lung by way of the lymphatics can be seen. In such cases it seems impossible to determine whether the nodes of the hilum are secondarily invaded. The bronchitic type of actinomycosis is more nearly approached; this is also recognized by pathologists. Combined with the pulmonary lesions is definite involvement of the pleura, either with or without fluid, and with a more or less fixed diaphragm. Characteristic of these pleural changes is marked thickening and very dense and broad pleural bands. However, a definite differential diagnostic sign from chronic empyema is not present. The same holds true in the cases of actinomycosis in which pleural involvement is the only sign, although a high diaphragm might lead one to suspect abdominal actinomycosis attacking the pleura by extension through the diaphragm. There were 4 cases of pleural

involvement alone in our series, and the roentgenograms of the thorax were not sufficient for the diagnosis of actinomycosis or even for a surmise of its existence.

There is only one roentgen sign which when present might help materially to establish a diagnosis of actinomycosis, that is, involvement of the ribs or sternum. This may be shown by areas of destruction, with or without the reaction of osteomyelitis around it, or periostitis. Not all sinuses of the thoracic wall lead to such areas in the bones; only 5 of our 14 cases furnished such evidence. Such signs, together with evidence of thickened pleura, empyema and pulmonary involvement, are more indicative of actinomycosis than of any other disease. Tuberculosis of the lung certainly will rarely, if ever, produce such a picture. A chronic abscess of the lung with empyema would not lead to destructive changes in the ribs. One must examine the ribs carefully, and often only a stereoroentgenogram will permit discovery of the pathologic changes. Without these changes in the rib purely roentgenologic differential diagnosis from chronic abscess of the lung with or without empyema, from chronic tuberculosis, or from chronic empyema with thickened pleura, seems impossible. The history, the general examination, and the search for the specific fungus, must then be called on for additional aid. A careful roentgenologic examination of the thorax should be made in all cases of particularly if thoracic actinomycosis, symptoms are present, or if the abdominal

cavity has been affected. The roentgenologic evidence may assist in the diagnosis and thus permit the institution of therapeutic measures sufficiently early to effect

SUMMARY

After reviewing the literature, the roentgenologic manifestations in 14 cases of thoracic actinomycosis observed at The Mayo Clinic are described. All the cases were proved by the demonstration of actinomyces in the sputum, in the discharge from the sinuses, or in the contents of empyema cavities. In 8 of the 14 cases a combination of pleural and pulmonary changes was observed. These consisted variously of enlargement of the hilum, infiltrative strands radiating into the lung from the hilum, localized consolidations in one or more lobes, pleural thickening, dense pleuritic adhesions, and fluid in the pleura. The manifestations were wholly pleural in 4 cases, and wholly pulmonary in 1 case. In 5 cases the pulmonary and pleural lesions were associated with areas of destruction in portions of the ribs or sternum, with or without osteomyelitis and periostitis; this combination is the sole roentgenologic syndrome which is more or less diagnostic, or at least strongly indicative, of actinomycosis. Careful roentgenologic examination of the thorax in all known cases of actinomycosis, particularly of the abdominal organs, would probably lead to earlier discovery of thoracic involvement and to better therapeutic results.

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A NOTE ON THE INTRAVENOUS USE OF AN IODIDE IN POSTOPERATIVE THYROTOXICOSIS*

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OSTOPERATIVE thyrotoxicosis, a devastating, often destructive metabolic storm, was formerly a comparatively frequent complication of the surgical effort to cure toxic goiter. It was especially frequent and dreaded in advanced cases of the group classified as "Exophthalmic Goiter." Ever since Plummer suggested the careful closely observed preoperative administration of Lugol's solution with frequent checking up of the metabolic rate in order to determine the day of maximum safety of operation this complication has melted away into comparative insignificance. Its importance and frequency have been further lessened by the postoperative administration of Lugol's solution by mouth or by rectum and the intravenous injection of glucose solution. An increasing reduction in postoperative toxicosis has developed as the operative technique has become more refined: less handling and pressure, less spilling of glandular juices, absolute hemostasis, vessels secured before severance, careful suturing of capsule, studious drainage, all these have contributed their share. (The discarding of general anesthesia by use of ether was an early step reducing morbidity.) There remain, therefore, but few cases in which this postoperative complication is a real danger. These few cases, however, demand special consideration, both because of their unexpectedness and rarity and the rapidity with which the surgeon exhausts his reliable remedial measures. When hypodermoclyses, glucose intravenously, and Lugol's solution have been faithfully administered and the patient made as comfortable as possible with small doses of morphine, we are done, at least we thought so until recently.

For eleven years we had no mortality

in these cases (not a large series) and comparatively infrequent morbidity of importance until the following case appeared:

M. L. No. 136806, female, forty-eight years old, married, was referred to the Methodist Episcopal Hospital by Dr. A. M. Bell of Sea Cliff, L. I. She has one living child, sixteen years of age, but has miscarried four times. Her family history was unimportant.

Her chief complaints upon admission to the Medical Service were "dizziness and nervous spells." These had been present for about two months. Her first attack coming on while she was shopping continued so long that the doctor was called and instigated careful investigation. Her admission to the Hospital (Medical Service of Dr. Cross) followed on March 29, 1930, two months after primary attack of dizziness. Other cardinal symptoms related in her history were sinus trouble relieved by treatment, but some tinnitus aurium persists, swelling in neck (thyroid) noticed for about ten years without symptoms until recently, occasional palpitation of heart. Examination revealed typical clinical picture of toxic adenoma of thyroid with hard nodule in right lobe and another in isthmus, marked exophthalmos, widened palpebral arches, marked tremor, tachycardia (120), dermatographia and marked excitability. Her blood pressure registered 138/78; metabolic rate was plus 72. During her stay in the Medical Service, rest in bed, Lugol's solution and unirritating laxatives were the essential forms of treatment. Her metabolic rate gradually declined until on April 26 the report read plus 11.8. The Medical Service considered that the desirable condition for operation had been secured, an opinion which we confirmed in consultation.

On April 28, thirty days after her admission to the Hospital, subtotal thyroidectomy was done, under gas-oxygen anesthesia preceded by routine hypodermic injection of morphine grain $\frac{1}{16}$ and atropine grain $\frac{1}{16}$. More than three-fourths of the right lobe (including a calcareous mass) and two-thirds of left lobe

^{*} From the Surgical Department of Methodist Episcopal Hospital. Submitted for publication December 11, 1930.

(containing a large cyst of colloid) were removed. The operation was of more than average difficulty. Hemorrhage was somewhat more than is usual with us. Time of operation, one hour and twenty minutes. Pulse rate before anesthesia was 120 varying but little during operation and was 120 and of good quality at its completion. Lugol's solution minims 10 every four hours was ordered, dose to be doubled per rectum if patient was nauseated. (We believe in taking great pains to avoid nausea in these cases.) The first twenty-four hours were uneventful. Thereafter ensued the typical postoperative complications with rising pulse, rising temperature, persistent and increasing nervousness and anxiety, dyspnea and after thirty-six hours an evident failure in circulation. Lugol's solution was increased in dosage. Fluids were given by hypodermoclyses. Glucose was introduced intravenously in doses of 250 c.c. of 10 per cent solution. Restlessness was treated by morphine. Seventy-two hours after operation the patient seemed moribund with livid countenance, pulse 180, respirations 36, tremor constant and restlessness and anxiety vying with prostration for supremacy. Drs. Frank B. Cross and Irving Cabot saw her in consultation. In view of the unanimous opinion of physicians and surgeons that the indicated remedy was iodine and because the Lugol's solution failed to meet this indication, sodium iodide solution was given intravenously, grain 15 at first followed by a similar dose after three hours. In four hours, Dr. deWitt, the enthusiastic house surgeon telephoned to me "A miracle has happened. This woman looks almost well." Our next observation confirmed this impression. The patient was calm, comfortable, with improved color, a smiling face, pulse 130, respirations 24 and in every way she showed a most gratifying improvement. Two doses were given at twelvehour intervals on the following day, then 10 grain doses twice a day for two days, followed by a gradual and satisfactory complete recovery. The behavior of the wound was ideal. The patient was carefully nourished. Iodide of iron was substituted for other iodine medication after five days. She was in a chair on the seventh day, and was discharged twenty-three days after operation (detained thus long because of homeward journey of thirty miles).

We reported this incident as of some therapeutic interest at the May, 1930,

Staff Conference of the Methodist Episcopal Hospital.

Five days later my colleague, Dr. A. H. Bogart, performed subtotal thyroidectomy in a girl of eighteen (No. 137855) who had had a metabolic rate of plus 50 four weeks before which had been reduced after rest and Lugol's solution to plus 8 on the day before operation. The standard procedure was done without unusual event of any kind. Immediately after operation (within five hours) a violent postoperative thyrotoxicosis supervened. No favorable results having been obtained by the usual measures including 20 minim doses of Lugol's solution, twelve hours after operation 15 grains of sodium iodide solution were administered intravenously, repeated after twelve, eighteen, and twenty-four hours, and thereafter twice a day for one day, then once a day for two days. The same prompt and dramatic recovery ensued as had been observed in our own case.

We submit this brief account to call attention to the direct intravenous use of sodium iodide in postoperative thyrotoxicosis. We believe it to be superior in promptness and certainty of action to oral or rectal exhibition of Lugol's solution. We are reasonably certain that it here saved two lives. That it may save more in this diminishing group of postoperative unfortunates is the object of this note.

The principle upon which the application of this therapeutic detail is based seems sound. As Dr. Cross remarked when we suggested this measure, "Iodine is Iodine." In the emergency cited iodine is indicated. Intravenous exhibition of iodine's sodium salt places the remedial chemical directly in the blood stream in which the thyroid toxins are circulating.

Extending the application of this principle it may reasonably become a more certain routine postoperative measure for the prevention of thyrotoxiciosis in any case where excessive bleeding, undesirable fragmentation, or unusual manipulation indicates the probability of the after-coming toxic storm. Furthermore intravenous use of sodium iodide solution may prove to be preferable to Lugol's solution by mouth in preparing highly toxic cases for operation.

TWO UNUSUAL CASES OF

PERINEPHRITIC ABSCESS*

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ILATERAL perinephritic abscess, although a comparatively rare disease, is probably not as uncommon as one is lead to believe by a review of the literature. Hunt,1 in 1924, reported only one in 106 cases of perinephritic abscess seen at the Mayo Clinic in ten years, and could find only 9 cases in the literature at that time. Yet several unpublished cases were mentioned in the discussion which followed the reading of his paper. Since that time several cases have been reported and perhaps a greater number have not been published. So this case is presented, not as so much of an oddity, as it is an illustration of how persistently the opposite side should be examined for suppurative perinephritis when the clinical course of a postoperative perinephritic abscess case is not satisfactory, because the diagnosis is often very difficult before the x-ray shows signs of a well-developed abscess.

Case 1. The case is that of an adult male, thirty-five years old, admitted to Dr. Henry G. Bugbee's service in the Lawrence Hospital in Bronxville, N. Y. on February 24, 1929.

Past History: Negative.

Present Illness: Began with an attack of influenza five years before admission. At the end of two weeks, the patient developed an intense pain which increased in severity for two days, then persisted as a dull pain in the right flank. Nausea, anorexia, fever, and great prostration have accompanied the pain in the side. There has been no dysuria, frequency, or hematuria.

Physical Examination: Shows a man acutely ill. Lies on his left side. He is acutely tender in the right flank; otherwise negative. Temperature varies between normal and 103.3°F. Pulse 80–100. Respirations 20–30. Urine: heavy trace of albumin, few mucous shreds, occasional flat epithelial cells, few leucocytes, and a few red blood corpuscles. Indican, acetone and diacetic, negative. Blood: 24,700 white blood corpuscles, 83 per cent polymorphonuclear leucocytes, lymphocytes 16 per cent, eosinophiles 1 per cent. X-ray: Figure 1

showed the left kidney normal in outline. Outer border of the rectus was distinct. The right kidney shadow and the outer border of the right rectus were obscured. There was no evidence of calculi. A diagnosis of right perinephritic abscess was made, and the right perirenal space was opened by the writer through a lumbar incision under nerve block anesthesia, and several ounces of foul, thick pus were evacuated. The wound was closed about a rubber tube drain. A culture of the pus showed Staphylococcus aureus.

The temperature became normal on the second day, and remained down until the seventh day, when it began to rise again. At this time, the urine was negative. X-ray of kidney, ureter, bladder was negative. Blood culture was negative. Blood count: w.B.C. 21,300, polymorphonuclears 87 per cent. The patient was very obstreperous and repeatedly pulled the tube out of the wound. These facts lead to a clinical diagnosis of retention in the right perinephritic area. Attempts to establish better drainage were unsuccessful. The temperture was intermittent between normal and 104°F. A cystoscopic examination at this time showed a negative bladder. The bladder urine showed a few pus cells. Catheterized specimens from the kidneys showed only a few leucocytes on the right side and no w.B.c. on the left. The urea on the right was 0.9, on the left 1.35. A culture showed Staphylococcus aureus.

The left side had never shown any tenderness or rigidity. X-rays had been repeatedly negative until April 5, when the x-ray (Fig. 2) first showed signs of obscuring the left psoas muscle and some enlargement of the left kidney. The pictures were not satisfactory because it was very difficult to rid the intestinal tract of gas. Pus was obtained from the left side with a needle, after which the left perinephritic space was opened and several ounces of pus evacuated. Culture showed Staphylococcus aureus. The temperature gradually subsided and was normal on the fourth day.

During this long period of suppuration, the patient had become extremely weak. The hemoglobin had decreased to 43 per cent. With the usual postoperative methods, including 500 c.c. of blood by the Unger method, his convales-

^{*} Read before the Section on Genito-Urinary Surgery, New York Academy of Medicine, January 21, 1931.

cence was progressive, and he was discharged as cured on May 18, 1929. He was seen one year after operation with negative urine findings,

ture, pulse and respirations were normal. The child looked chronically ill.

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General Physical Examination: Was negative,



Fig. 1.

Fig. 2.

and no urinary symptoms. He had regained his weight and strength and was carrying on his daily work as a laborer.

CASE 11. A female child seven years old, admitted to the Hospital for the Ruptured and Crippled, May 3, 1929.

Past History: Negative.

Present Illness: Six months before, she had had a tonsillectomy. She had a normal convalescence, and seemed in good health for four weeks, when she began to complain of pain in her right side. A diagnosis of acute appendicitis was made and an appendectomy performed in a local hospital. The appendix was not diseased. She continued to have pain and fever and remained in the hospital for thirteen weeks. When she returned to her home, she could not walk erect, but bent towards the right side. X-rays taken at that time were negative. She then had intermittent attacks of fever, the last attack being three weeks before admission. She did not seem to improve. Three days before, her mother first noticed a lump in her right flank. She had no urinary symptoms.

At this time, she was admitted to the Hospital for the Ruptured and Crippled. Temperaexcept for fullness in the right flank, which gave an appearance of a deep seated tumor, posteriorly. Urine: Catheterized bladder specimen showed a trace of albumin, many pus cells, no clumps. Blood: w. B. C. 17,500 with 64 per cent polymorphonuclear leucocytes. The R.B.C. showed a slight central pallor. A dry tap had been made and perinephritic abscess had been ruled out.

She was then seen by the writer in consultation. X-ray of the urinary tract showed increased soft tissue density over the right kidney region, and an obliteration of the outline of the right psoas muscle. Cystoscopic examination showed a normal bladder. No. 5 French catheters were admitted easily to both renal pelves. The right ureter showed four leucocytes per field. The left ureter showed 8 leucocytes per field with some clumps. A diagnosis of an old perinephritic abscess was made, and under general anesthesia, an old broken-down abscess cavity was evacuated. A pathological diagnosis of chronic suppurative inflammatory tissue was made from some of the tissue which came away with the pus. The child had an uneventful recovery and was discharged from the

hospital June 14, 1929, when there was still a very slight serous discharge from the wound. She was advised to return for follow up, but



Fig. 3.

because of the remoteness of her home, she was not seen until November 6, 1930, at which time, she was readmitted to the hospital.

Her father said that she had never been free from drainage in her side, although there had never been more than enough to saturate one gauze wipe in twenty-four hours. The child had grown, had gained considerable weight, and looked quite robust. She had had no urinary symptoms, except an occasional enuresis.

Urine analysis showed 12-15 pus cells per field, with occasional small clumps. The urine specimens collected at half-hour intervals, following the intramuscular injection of phenol-sulphonephthalein showed a reading of 55-30-10 for a total of 95 per cent.

A plain x-ray (Fig. 3) showed no kidney outline on the right side, the outline of an enlarged kidney on the left. There was a shadow in the region of the lower pole of the left kidney which proved to be extraurinary. A lateral view (Fig. 4) shows it to be well anterior. The x-ray (Fig. 5) taken after the injection of the sinus tract with lipiodol, showed that the sinus tract connected with the kidney pelvis. The solution then ran down the ureter and appeared

as isolated droplets in the bladder. The lipiodol was then found in a voided specimen of urine. This x-ray also showed the extraurinary shadow



Fig. 4.

lying over the left border of the fourth lumbar vertebra. The x-rays after the injection of uroselectan showed a normal excretion of the dye from a left hypertrophied kidney, and no excretion of the dye from the right side.

Cystoscopic examination showed a negative bladder, except for the congestion of the right ureteral orifice. A No. 5 French catheter was passed easily to the left kidney, and a clear specimen with normal urea content was obtained. The right ureter could not be catheterized beyond 2 cm., and no further attempts were made because the examination was done without anesthesia, at the child's request, and because lipiodol had shown the ureter to be patent, and uroselectan had shown the kidney to be functionless.

Exploratory operation was done on December 3, 1930, with the hopes of removing the functionless right kidney. The kidney was difficult to expose because of the dense perirenal tissue caused by an abscess of five months' duration followed by a chronic productive inflammation of one and one-half years' duration. The kidney was finally exposed and found to be atrophic, measuring about 1½ in. in length. Exposure of the hilus and subsequent

nephrectomy were considered too hazardous. The extrarenal sinus tract was removed in its entirety, and the defect in the kidney closed

Hunt's article, mentioned before, was very convincing because 55.7 per cent of his 106 cases showed no demonstrable kidney



Fig. 5.

over by a suture of the capsule. The wound was closed about two rubber dam drains.

The child had a very marked febrile reaction immediately following the operation, which lasted about four days. Since then, there has been a gradual improvement. She is now ready to leave the hospital. Her side has healed. The urine analysis is negative.

This is a case of a perinephritic abscess caused by a cortical abscess, which gave no urinary findings at the time of operation; yet, in spite of adequate drainage, subsequently broke into the pelvis, and ultimately destroyed the kidney.

With the turn of the present century, urologists began to doubt if perinephritic abscess ever occurred without renal disease. Ocherblad² gives Ramon Guiteras credit for first calling this to his attention in 1906. Braasch,³ in 1915, said he felt sure that the kidney was the seat of origin of all perinephritic abscesses, and he came to this conclusion after the study of 6⁻ cases which he reported at that time.

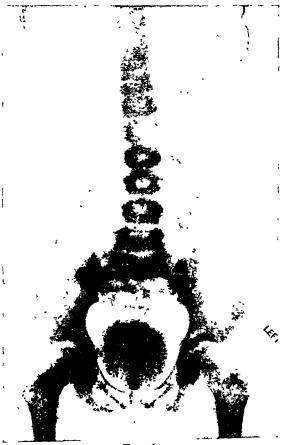


Fig. 6.

lesion, yet cortical abscesses were found in 31 of these at operation. He also reported that cortical abscesses were found in 9.7 per cent of 1835 nephrectomies performed at the Mayo Clinic. These and other publications have led to the almost universal conception of the kidney as the seat of origin of all perinephritic abscesses.

The 2 cases here presented concur with this opinion, both occurring following peripheral infection, and both showing renal disease. The first cases showed pure cultures of Staphylococcus aureus from both perinephritic abscesses, as well as from cystoscopic urine specimens collected from each kidney. In the second case, the renal origin is very obvious.

[For References, see p. 33.] [For Discussion, see p. 21.]

POSTOPERATIVE CARE OF UROLOGICAL CASES*

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THE successful handling of a urological surgical case is directly dependent upon an accurate diagnosis, thorough preparation of the patient for operation, a well conceived and executed operative technique, and intelligent postoperative care.

Accuracy in urological diagnosis, thanks to our ever increasing armamentarium, including cystoscopy, x-rays, urography and intravenous urography, is possible in nearly every case; with all these methods at hand, however, a prolonged study of the case may be necessary for its accomplishment.

The value and necessity of preparation of the patient for a urological operation have been repeatedly emphasized by many and frequent contributions to the literature, and yet too much stress cannot be laid on this phase of the case. The present opportunities for studying the general physical condition of the patient, often in association with a competent internist, the many precise methods at our disposal of estimating the efficiency of the cardiovascular system and of the kidneys, with electrocardiograms and laboratory tests of blood chemistry and renal function, should give a sense of security that should leave little to be wanting regarding this phase of the case.

With the background of an accurate diagnosis and a thorough preparation of the patient for operation, an operative technique should be followed that aims towards elimination of the pathology and restoration of function, employing measures tending to minimize operative complications.

Much less has been written about the postoperative care of urological cases. The immediate care has been included in considerations of operative technique, and yet little or nothing said of their remote care.

There is no group of cases in any branch of surgery in which the remote care is more important, from the standpoint of restoration of function, permanence of cure, and general rehabilitation of the patient.

In the immediate postoperative care, there are certain general principles which are applicable to all urological cases, namely: the necessity of free drainage, forced elimination, control of hemorrhage, and stabilization of the circulation. The more satisfactory and complete the preoperative preparation, and the more accurate and finished the operative technique, the less urgent will be the immediate postoperative steps, and the more readily will the patient respond to such measures.

In all urological cases, an immediate increase in the intake of fluids is indicated, for, as the prime function of this tract is elimination, to maintain this function there must be a free supply of fluids to the body; this is administered in all post-operative cases by hypodermoclysis at the completion of the operation, by rectal injection, and by mouth, as a large percentage of urological operations are carried out under regional anesthesia.

The blood is typed before operation, that a transfusion may be given at any time, if necessary. No fixed rules or routine are followed out, but indications are met as they arise in individual cases. This applies to medication, nourishment, care of wounds, dressings, bladder irrigations, and the activity of the patient.

It has seemed to me that special considerations are due, from a postoperative standpoint, to definite classes of urological surgical cases most commonly encountered. These I would divide into (1) cases of prostatic obstruction, (2) lithiasis, (3) tuberculosis, and (4) malignancy.

The immediate postoperative care of

^{*} Presented before the Section on Genito-Urinary Surgery, New York Academy of Medicine, January 21, 1931.

cases of prostatic obstruction is so intimately associated with the preoperative preparation and the operative technique. that one can hardly discuss one without referring to the other. The patient thoroughly stabilized through proper preparation, which means that he has reached the height of his cardiovascular-renal efficiency and body elimination, together with relief of local congestion and infection, will approach the operation of prostatectomy with a reasonable assurance of a more comfortable convalescence and an expectation of fewer complications, especially if the operation is carried out under local anesthesia, with a minimum of shock, traumatism and hemorrhage. This is best accomplished by a preliminary cystostomy and ligation of the vasa deferentia. Preliminary cystostomy is often the most vital step of the operation, frequently carrying with it a more pronounced systemic reaction than the subsequent prostatectomy; therefore the care following cystostomy is most important, and consists in forced elimination by increased fluid intake, through hypodermoclyses, proctoclyses, intravenous infusions and transfusions, if necessary. Increased elimination from the intestinal tract is important. During this stage, digitalis is a valuable drug in stabilizing the circulation and stimulating renal activity. Early moving about of the patient, out of bed, is beneficial.

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While hemorrhage is much less pronounced in a secondary prostatectomy, yet its control goes far towards eliminating postoperative shock.

The hemostatic bag has been the most satisfactory method of controlling hemorrhage, and has been used in most cases. Occasionally the prostatic cavity is packed with gauze placed about an indwelling urethral catheter. Traction on the hemostatic bag is seldom maintained over two hours. The bag or packing is retained in position from twenty-four to forty-eight hours and removed, an indwelling catheter replacing the bag.

Postoperative hemorrhage may occur when least expected. I have had but one hemorrhage during the first twenty-four hours, with the bag in position, and this case proved to be a hemophiliac. The bleeding was controlled by packing. Another case, in which the bag was not used, had a severe hemorrhage which was controlled by inserting the bag. A sudden severe hemorrhage occurred, in one instance, one week after operation, necessitating packing of the bladder, and still another case had repeated hemorrhages, apparently due to infection; they were controlled by repeated packing of the bladder. While none of the cases proved fatal, one must be constantly on guard against the possibility of postoperative hemorrhage, and be prepared to pack the bladder. A transfusion should be given at once, following a hemorrhage.

Local infection of the bladder, prevesical space, or the wound, has not been pronounced in any cases during recent years, since a longer preoperative period of bladder drainage has been given by urethral catheter, and supplemented by cystostomy.

During convalescence, fluid intake should be maintained at a high level, by all methods of administration.

One of the most troublesome and often serious complications following prostatectomy has been the large percentage of cases of epididymitis. The seminal vesicles are always infected at some time during a prostatectomy, but this infection clears up rapidly if it does not extend to the epididymes, as has been clearly proved since ligating the vas as a routine, during the past year and a half. Epididymitis has occurred in three instances after ligation; one of these patients had an epididymitis before entering the hospital, and the other two had a well-marked seminal vesiculitis before the ligation, and in all probability the infection already involved the epididymes as well. In these cases the attack was less pronounced and of shorter duration than in other cases in

which ligation had not been carried out.

The elimination of this complication removes one of the most trying immediate and remote complications of prostatectomy, one that is painful, distressing, and one that greatly weakens and lowers the morale of the convalescent.

Very little emphasis has been placed upon the continued care and observation of the patient after prostatectomy. To turn such a patient out of the hospital with the healing of his wound, with no instructions as to further care, is entirely wrong.

It has been my experience that these men of advanced years are decidedly weakened by the operation, and how much so may only be appreciated as they begin to resume activity. Under mental and physical effort they tire readily. The circulation often shows impairment for a long period of time. Edema of the extremities is not uncommon; phlebitis is an occasional complication. Such patients should be under the observation of the urologist and the internist until brought back to their best possible physical condition.

Continued observation after operation shows remarkably good urinary function in almost every case. Wounds heal readily as infection is cleared up before operation. Contracture of the vesical neck, requiring dilatation, has been noted only in a few cases of fibrous prostate removed by enucleation or by the punch operation, and in one case of prostatic calculi with long-standing infection of the prostate and vesicles.

The prostatic capsule often becomes much thickened after operation, probably due to small compressed pieces of adherent prostatic tissue which are not removed, and which later undergo hypertrophy. Routine rectal examinations subsequent to operation, often show, months or years later, apparently a considerable amount of prostate. In none of our cases have I seen any obstruction from this cause, but

I have re-operated upon three patients originally operated elsewhere.

All cases of fibrous prostate should be under observation for an indefinite period. Occasional dilatation of the vesical neck or repetition of the punch operation may be necessary. Atony of the bladder muscle slowly improves as the relief of obstruction is maintained.

Expression of the contents of the seminal vesicles should be carried out at intervals until they are found to be clear of infection. It often requires years for such infections to subside; occasionally they give rise to attacks of neuritis and arthritis, although, as before stated, with ligation of the vas, these infections have been less persistent.

The following urological lesions have been encountered in conjunction with prostatic observation: vesical calculus, vesical tumor and diverticulum, ureteral calculus, renal calculus, and pyonephrosis. In cases of vesical calculus, tumor or diverticulum of the bladder, such lesions were removed before doing a prostatectomy. In the cases of ureteral calculus, renal calculus and pyonephrosis, no operation was done prior to the prostatectomy, but the necessity of watching such cases after prostatectomy, is obvious, and subsequent operations for their removal should be carried out, if indications arise.

The association of the formation of urinary calculi with the presence of focal infections in and outside of the urinary tract, the close connection between interference of urinary drainage from the bladder or kidneys, also disturbed body chemistry and poor intestinal function, with the production of calculi, is such that a satisfactory result in any given case of lithiasis must depend not alone upon operative relief, subsequent to an accurate diagnosis and preoperative preparation, but upon the after care of the patient, in an attempt to restore function to its maximum and prevent the re-formation of calculi.

The maintenance of free urinary drainage, employment of kidney lavage, forced fluids, and urinary antiseptics, in an

attempt to eliminate infections of the urinary tract, will prove of decided value in preventing the recurrence of calculi. All cases of lithiasis should be under periodical observation for an indefinite period, and should have a check with x-rays from time to time. Even under the closest observation, and the employment of every known means of precaution and treatment, calculi may re-form; in such instances, however, much benefit will be derived from these measures.

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When one realizes how many cases of lithiasis require nephrectomy; how many cases are bilateral; the frequent combination of renal and ureteral calculi; and the frequency of coexisting infections throughout the urinary tract, the importance of conservative surgery and the restoration of function and elimination of infection in the operated kidney or in the remaining kidney, if nephrectomy has been necessary. is appreciated. A recurrence following nephrectomy means operating upon a single kidney. The possibilities of restoration of function from postoperative treatment leads one to adopt conservative surgery if possible, and the amount of restoration of function which takes place in some cases, is often most surprising.

A man of fifty-four was operated on eighteen months ago for the removal of a giant calculus from the left ureter. The calculus filled the ureter from the bladder to a point above the pelvic brim. The ureter was enormously dilated, the kidney showed infection and poor function, no dye appearing in the urine from this side. Following a uretero-lithotomy, the kidney examined one year later showed good function and only a slight infection. This patient has been under medical observation and has no urinary symptoms.

A child four years of age was operated fifteen months ago for a large vesical calculus and a large calculus in the right ureter. She has been under postoperative care and is now free of infection with good function of both kidneys and no recurrence.

as shown by x-rays taken during the past week.

The elimination of focal infections so frequently found about the teeth, in the tonsils and sinuses, should be an important element in the postoperative treatment of lithiasis.

By means of diet, medication, and increased elimination from the intestines, calcium oxalate, and uric acid crystals may disappear from the urine, and often by changing the reaction of the urine phosphaturia may be controlled.

In one patient under observation for the past ten years, during which time I operated upon both kidneys and one ureter for large obstructing calculi, it has been difficult to maintain an acid urine, and to hold the kidney infection in check, yet under the previously mentioned routine of diet, medication, and kidney lavage, a calculus which re-formed in each kidney, has not changed in size during the past two years, and the patient is comfortable.

Under such postoperative treatment, recurrences in cases of lithiasis have been rare.

It is generally conceded that tuberculosis of the genito-urinary tract is not a primary lesion, but secondary to a tuberculous focus elsewhere in the body, which has lighted up during a period of lowered body resistance. At such a time, patients are poor operative risks and should be placed upon a regime which will improve their resistance and diminish the activity of the acute lesion, before operative interference is undertaken. Even when this has been accomplished, operation such as nephrectomy or epididymectomy often results in renewed activity in secondary tuberculous lesions in the genitourinary tract, as in ureter or bladder after nephrectomy, and prostate and vesicles after epididymectomy. Quiescent foci in other parts of the body may become active, so that after operation, every effort should be made to increase body resistance. Exposure of wounds to sunlight and the Alpine lamp is most beneficial. Santol-ol is soothing to

the bladder lesions. Tuberculin may often be administered with benefit.

Tonics and open air are indicated, and as soon as possible following operation, the patient should be moved to the best possible climate, and treated as a case of general tuberculosis, by rest, open air, and general supportive treatment.

To discharge a patient from the hospital, following an operation for tuberculosis of the kidney, with no instructions and no further watching, may be worse than not operating. A tuberculous ureter may continue active, and bladder lesions may not heal. Symptoms continue, the opposite kidney may become involved, or other active foci lead to an early mortality, while, under more favorable surroundings and intelligent care, a cure would be probable.

Three patients having bilateral tuberculosis, in whom the process became arrested in one kidney, were subjected to nephrectomy, the more extensively involved kidney being removed, and under general postoperative treatment, all are alive, one, five years after operation. One patient having a single tuberculous kidney has been under observation for sixteen years, and under general systemic care, is enjoying good health and is free from urinary symptoms. Exploratory laparotomy proved the absence of the opposite kidney.

A realization of such forces of nature should be recognized and utilized to the utmost, observations being continued over an indefinite period of time.

The postoperative care of urological cases of malignancy might be summed up in the words "eternal vigilance." Whether the growth be in prostate, bladder, kidney, or in the testicle, and the operation be a radical removal of the tumor, if fortunately diagnosed at an early stage, when removal may be possible; or whether the growth be treated by radium, diathermy or deep radiation, in an attempt to destroy or control it, the future of the case depends upon regularly repeated observations.

Furthermore, only by such postoperative care is it possible to evaluate the different methods at our disposal, of treating malignancy.

I would like to cite a few cases which I believe justify the importance of such postoperative care.

J. P. Complete retention of urine in 1920. Cystotomy revealed a carcinoma of the prostate. Radium needles were inserted suprapubically and through the perineum. Suprapubic wound healed four weeks later. Toxemia subsided. Complete return of urinary function. Radium administered one year later. Patient under periodical observation and general tonic treatment. Prostate now small, smooth, no nodules. Gained 25 lb.; in excellent health.

A. T. Carcinoma of prostate, 1922, (prostate large, stony hard, nodular, fixed). Radium needles inserted through the perineum; residual reduced from 4 oz. to none. One year later needles again inserted for slight recurrence. Since then, under regular examination and cystoscopy, shows no recurrence, is well, has good function.

Nine patients undergoing prostatectomy since 1022 showed, on pathological section, a carcinoma with prostatic hypertrophy. One case developed general carcinomatosis one year later. A second shows a small hard nodule in the prostatic capsule which has not increased in size for two years. The others have shown no recurrence.

A patient with a stony hard nodule of carcinoma recurring after a partial prostatectomy, has been made comfortable by radium seeds inserted into the growth through the perineum.

X-ray films showing the position and number of radium seeds that have been inserted, are taken at intervals, and, in conjunction with other urological examinations, are an aid in checking off the condition, and as a guide for further radium treatments.

This postoperative care has shown that much can be done in some cases of carcinoma of the prostate in giving prolonged relief, and occasionally effecting a cure, in this most difficult and distressing class of cases.

These remarks are more applicable to

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cases of bladder tumors, where recurrences are noted in such a large percentage of cases, and in which recurrences may be detected easily by cystoscopic examination. Recurrences respond more favorably and more rapidly to fulguration than do the primary growths, especially after radiation, and they may often be eradicated if detected in their incipiency. Here deep radiotherapy and radium are valuable adjuncts, often advantageously applied together. Results will be in direct proportion to the time at which the growths are detected and treated.

It is customary to have cases of bladder tumor return for observation every month after operation. Later, the intervals are lengthened, but not over six months, for the first five years.

One case of extensive infiltrating carcinoma of the bladder has been free of recurrence for nine years, after radium implantations. A second patient, having the infiltrating type, was re-operated three years ago, radium seeds again implanted, was then given radiotherapy, and the bladder has been clear of growth since that time. In this case, a radium seed was recently removed from the bladder wall three years after implantation, leaving a smooth, cupped-out area. A case of papillary carcinoma operated seven years ago by resection, developed a small recurrence five years later, which was removed by fulguration, and has been free of growth since then. Another case resected sixteen years ago has developed numerous small recurrences, which were detected by periodical cystoscopic examinations, although no symptoms were present. These recurrences have been destroyed by fulguration, and the patient is now clear of growth.

Many similar instances might be mentioned which demonstrate the value of postoperative care of cases of bladder tumors, the necessity of periodic cystoscopic examinations, and the possibility of maintaining freedom from growth by the early detection and eradication of recurrences. The absolute necessity of such

a course should be fully explained to the patient, and he should be held responsible for its fulfillment.

The possibility of recurrence of renal tumors, especially of those of the renal pelvis in the ureter and bladder, if a nephroureterectomy has not been carried out as a primary operation should be remembered and periodical cystoscopic examinations made, in hopes of detecting such recurrences at once. Cases of renal tumor should be examined regularly for the presence of metastases. Deep radiotherapy of the kidney region may be beneficial in inhibiting local recurrences.

In all cases of tumor of the testicle, deep radiotherapy should be applied to the wound region, inguinal and renal regions, after the removal of the growth. Some observers advise radiotheraphy before, as well as after operation. Two patients with carcinoma of the testicle, given radiotherapy after removal of the growth, have been free of recurrence five and three years after operation.

One might infer from these remarks that, once a urological case, always a urological case, which is true to the extent that the urological history should always be borne in mind in questions of health that may subsequently arise in the individual.

The intimate connection of surgical lesions of the urinary tract with the remainder of the body, such as prostatic obstruction with kidney function and the circulatory system; tuberculosis with tuberculous lesions in other parts of the body; lithiasis with the various body functions and focal infections; and malignancy with metastases, render a study of the whole body imperative, and a proper restoration of function and health, with a maintenance of the same dependent upon a carrythrough. This means the utilization of every means of postoperative treatment, and continued observation over long periods of time, with the employment of suitable measures at a time when recurrences of pathology are detected in their incipiency and may be eradicated.

In no other class of cases is this followthrough of more importance, and the urologist holds no claim to results until the patient has been placed upon his feet, free from complications, and has passed the probable period of relapses and recurrences.

As before stated, true evaluation of various urological procedures can only be determined by such postoperative study.

From time to time there is a burst of enthusiasm for an operative procedure seemingly new, yet, upon investigation, found to have been tried out years before. With refinements in our diagnostic technique, methods are resurrected, and reports comprising the immediate results from such procedures are often voluminous and optimistic; yet how seldom are these reports supplemented by others giving ultimate results five or ten years later.

The so-called elusive ulcer of ten years ago was looked upon as a pathological entity to be cured by bladder resection. The immediate results of operation seemed to be excellent; yet as time went on, postoperative observations and treatment showed that recurrences were the rule, that the lesion was an interstitial cystitis, that elimination of focal infections of the kidney and outside the urinary tract was necessary to effect a cure, and, furthermore, that local treatment of the ulcers by instillations of silver nitrate and by fulguration, gave better results than resection of the bladder.

Less and less is heard of ureteral strictures as a pathological entity. Continued care and observation of cases so diagnosed, have demonstrated their connection with other lesions, and a broader comprehension of this subject has lead to a dampening of enthusiasm for specific operative methods of relief, with a substitution of a line of treatment aimed to relieve a condition of which ureteral pathology or disturbed ureteral function is an integral part.

The past few years have seen a renas-

cence of kidney fixation, largely due to present methods of urological diagnosis, in part, to the fact that attention has been focused upon the ureter as a cause for symptoms. The period of enthusiasm of thirty years ago is more or less forgotten, and while the pendulum may have swung too far in the opposite direction, there undoubtedly being an indication for nephropexy in carefully selected cases, yet this present stage should be supplemented by postoperative observations made over a period of years, with accurate reports as to the permanency of symptomatic relief. The same holds true for plastic operations upon the renal pelvis.

It was to be expected with the perfection of cystoscopes and ureteroscopes that further attempts would be made to relieve vesical neck obstructions by various palliative operative methods, and here again postoperative study, and records extending over a period of years, are necessary to give a true evaluation of the results of such methods.

There are many difficult problems in urology, how difficult can only be appreciated by reviewing the literature of the specialty and a study of the various means that have been devised to combat these problems. Enthusiasm, while of value, should be tempered by results, which, in turn, must be viewed over periods of years.

Every pathological entity and operative technique eventually finds its proper place. This, however, is only determined by prolonged postoperative study.

In urological surgery we are not alone concerned with the question of mortality, but with the restoration and maintenance of function and good health.

DISCUSSION OF PAPERS BY DRS. TAYLOR AND BUGBEE

Dr. B. S. Barringer: If after an operation you are called up by an anxious house staff because the patient is bleeding or doing badly, there has probably been some lack in the preoperative care or operation, or a matter called

luck has gone against you. Such patients have probably not more than a 75 per cent chance of living. The preoperative care of these patients is very important, as Dr. Bugbee has emphasized.

As for the postoperative complication of hemorrhage; I do not ordinarily use packing, but if a general surgeon, who is accustomed to packing, has charge of the case, I use it, too. He would not know how to manage anything else and I find that is a very sane procedure. I have seen cases that packing would not control. If the patient has no prostate cavity, packing does not stay put. The hemorrhage is controlled by a little gauze down to the bleeding point. I have seen a patient die immediately on the removal of the packing, I do not know why, whether from shock or embolus. If the packing is difficult to take out, leave it alone until it is ready to do so. I agree with Dr. Bugbee that the bag is the thing to use.

A failing kidney function postoperative is rare. I think it usually occurs with a failing heart function. You see the patient not doing well, and then you find the urea, etc., going up; and if you are wise you will go over the heart carefully and will probably find that proper

digitilization will bring it back.

Another complication is paralytic ileus. I see very few cases of this; I do not know why except that I think perhaps because I use spinal anesthesia almost exclusively. Last week I had a case in which I could not use spinal anesthesia. The patient had a moderate stone in the kidney which necessitated pyelotomy. He had general anesthesia, and died of paralytic ileus. There is something in spinal anesthesia which seems to me to make the postoperative convalescence unusually good.

As for epididymitis, I do not do the routine ligation of the vas, because I see very few cases of epididymitis; and while the prostates I see are few compared with the bladder tumors the proposition is the same; I think one reason may be that I do not put catheters in the urethra postoperatively unless there is a very good cause. After taking out the packing or bag from the prostate, I do not put a urethral

catheter in place.

Dr. Bugbee's point that it takes a long time for a prostatic to get entirely well, is well taken. It requires at least six months for the patient to get back his vigor and weight, and we ought all to realize that. A word about carcinoma of the prostate: Some years ago I made a rash statement that 10 per cent of such cases are controlled by radiation through the peritoneum. I still hold to that. But most cases are radiated too little. I therefore put in radium suprapubically, which means a 5 per cent mortality. I do this because I believe we can gain another 5 per cent, and go from 10 to 15 per cent in controlling prostatic carcinoma.

A word about the postoperative care of bladder tumors that have been radiated. I am loath to instrument these for a long time, and I keep all instruments out of the bladder for a number of months if possible. You are fairly safe if your radiation has been done carefully; but if your patient bleeds after you have radiated the bladder tumor that patient has in 70 per cent of cases a recurrence. If he does not bleed, let him go four to six months before you cystoscope him.

DR. EDWIN BEER: Referring to Dr. Taylor's paper on perinephric abscess, during twenty-odd years only 3 cases of bilateral cortical kidney abscess, usually due to staphlococcus

aureus, have been seen by me.

Most perinephric infections are due to cortical kidney abscess, and the earlier one operates, the more easily this origin is demonstrated. Late operations for perinephric abscesses do not expose the kidney. In earlier operations, when the pathology is just beginning, the kidney is usually seen or felt, and the surface cortical suppuration is readily detected. It is perfectly conceivable that some cases may start in the perinephric fat, some cases by extension of adjacent suppuration. Many cases are due to a mild bacterial infection, and the symptoms are protracted and very difficult to interpret; in fact, I nave seen some cases run two and a half years before correct interpretation and treatment. Only recently we have had 3 of these cases on my service at Mount Sinai Hospital.

One was a child, who had been suffering from febrile attacks for almost two years. Intravenous pyelogram, made with either uroselectan or skiodan, I have forgotten which, suggested a neoplasm. Local tenderness suggested a cortical carbuncle, which was found at operation. Usually in these cases, the perinephric fat is very much indurated, and thickened; at times it has been seen to be as thick as the shell of a cocoanut. In this case the perinephric

reaction was purely local in and about the region of the cortical carbuncle on the anterior surface of the kidney. This was separated, and the perinephric ab scess, which led down to the kidney, was drained, the kidney being saved.

These ante-renal suppurations are particularly misleading, as they produce intra-abdominal peritoneal symptoms. Another patient, very similar to this child, had a cortical abscess, which was peracute, on the anterior surface of the kidney, which in some way affected the vascular supply of the lower two-thirds of the kidney. The patient, following incision and drainage with decapsulation of the kidney, continued to run temperature, which could not be explained by retention, as the wound was digitally explored regularly for several weeks, and no pus found. In this case, a secondary nephrectomy led to a cure, the lower two-thirds of the kidney being out of commission.

Another case, operated upon at a somewhat later stage, was incised and drained, kidney not seen or felt. In this recent series of 3 cases, in 2 out of 3 the origin of the perinephric suppuration was demonstrable as a cortical kidney lesion.

It is important in these cases to be sure, if the patient's temperature continues, that the second kidney is not involved, as occasionally bilateral cortical abscesses are encountered, and if one is too radical at the first operation and removes the kidney, and subsequently the second kidney has a similar infection, the patient is likely to be in difficulty.

As far as x-ray diagnosis is concerned, although not present in all cases, obliteration of the psoas muscle and curvature of the spine to the opposite side has proved a great aid as a confirmatory physical sign. Frequently x-ray has suggested the possibility of perinephric suppuration, when previously the physician had scarcely thought of this possibility. During the last year such a perinephric abscess was recognized by the x-ray department in a patient on whom I had done a nephrectomy years before. For a long time I could not convince myself that she was tender and had perinephric suppuration. The stump of ureter on that side showed no retention. X-ray showed typical signs. Finally, when tenderness and pain in the right lumbar gutter became more evident, a large pus pocket was evacuated from the side where the kidney had been removed. Subsequent observation of this case showed that the abscess started in a diseased spine.

My experience points against the use of aspirating needle for diagnosis in these perinephric suppurations, as I believe aspiration is occasionally likely to be a dangerous procedure. Sometimes the needle traverses the kidney and produces an abscess in this organ, especially when it first traverses the infected abscess and then enters the kidney. I believe diagnosis should be made without aspiration and confirmed by exploratory incision if necessary. If one relies upon a negative aspiration and does not incise and drain, one may make a serious mistake, as the pus may be too thick, or it may not be located in the path of the needle.

As for Dr. Bugbee's discussion, he has covered the whole field, and I can only express my approval of his careful, complete work. In the case of prostatics, I believe that after prostatectomy serious bleeding which is uncontrollable is rare, if one uses a very large drainage tube. If the tube is too small and the blood clots within it, the tendency is to spread open the prostatic bed, which allows the vessels to open up and bleed. In addition to the large tube, a long packing of gauze soaked in thromboplastin seems to be of assistance. The end of this is slipped into the prostatic bed, the balance of the gauze remaining in the bladder, so that it compresses the neck of this organ where the bleeding usually arises. The tube presses against this gauze, as the patient sits up in bed right after the operation, and the large tube, plus gauze and the sitting position, seems to be effective. Thromboplastin probably helps to some extent.

On removing the packing, one can do so painlessly by introducing some novocaine through the drainage tube about half an hour before the gauze is removed. The novocaine is poured in through the suprapubic tube, which has been disconnected from the urinal. The tube is clamped off, and in twenty to thirty minutes the dressing is done, tube removed and the gauze easily and painlessly extracted. The extraction of the gauze used to be more painful than anything else. By this simple method the pain is reduced to a minimum. At the same time that the gauze and the tube are taken out. the urethra is washed through so that free flow of water pours from the suprapubic wound. If there is any bleeding following this procedure. the bladder is washed out and a tube of smaller caliber introduced for a day or two. When the bleeding has ceased, one of my suprapubic cups is attached, and the patient left absolutely alone without instrumentation until his bladder is closed. If there is a long delay, the patient not voiding for three weeks or so, an indwelling catheter may be introduced to deflect the stream from the sinus and the cup.

Occasionally there is bleeding a week or so after removal of the packing due to separation of some sloughs or tabs. If this is severe, it may have to be controlled by repacking, but usually reintroduction of a large suprapubic tube with hot irrigations will control the situation. Only in very severe secondary hemorrhages, which are rare, is transfusion, etc., required.

Occasionally following prostatectomy, when the patient is healed, one sees an obstruction due to narrowing of the neck of the bladder. At times one sees a diaphragm which is formed at the neck of the bladder. These formations may lead to slow healing of the wound, though there are many other causes for persistent suprapubic fistula following protatectomy. Fortunately most of these causes can be relieved by passage of a sound which separates the adhesions which have formed abnormally at the neck of the bladder. Some cases, however, have to be re-operated upon, and the deformity excised.

Another complication, which is rare, is a certain degree of incontinence. This is usually relieved by re-education or by instillations into the posterior urethra of silver. Whether these complications are due to injury of the sphincter or are due to overpacking in the prostatic bed is difficult to determine. In all cases there is serious injury to the internal sphincter, as is evidenced by cysto-urethroscopy, by x-ray studies of the posterior urethra after prostatectomy, and by the fact that the patient retrojects into the bladder. Whether this same retrojection occurs after perineal prostatectomy as after suprapubic prostatectomy I have not been able to find out.

In my experience these old gentlemen made a very quick convalescence. Within two or three months after discharge from the hospital they are quite spry and active. In some of them the urine becomes quite clear, or absolutely clear. In those whose bladders were very distended for some time prior to operation and in which many pouches have developed, absolutely clear postoperative urine is probably never obtained. I have, however, repeatedly seen clear urine, without any evidence of macroscopic pus in cases where the bladder was not deformed.

I agree with Dr. Bugbee that stones and diverticulae should be removed at the first step, before prostatectomy is done.

In the study of the x-ray treatment of tumors, whether they be primary tumors or recurrences; whether they be renal or bladder, I have seen no results.

In tumors within the pelvis of the kidney, the only surgical treatment is complete nephroureterectomy with excision of the meatus in the bladder. Recurrences in the ureter stump are so frequent in these papillary tumors of the pelvis of the kidney that one should do a complete operation at the first stage, rather than go in after the ureter secondarily.

In tuberculosis of the urinary tract, the operation is only part of the treatment. Patients who can take care of themselves, look after their personal hygiene, are much better off prognostically than the poor patient, who has to get to work. Postoperative hygiene is most important and surely will improve the end-result.

Dr. Bugbee's female patient who ran for sixteen years with renal tuberculosis and is still alive with clear urine is surely a very exceptional observation. If the case had occurred in a male, I might have been in doubt as to contamination of specimens from a prostatic tuberculosis.

In the treatment of carcinoma of the prostate, in view of the great variety of courses that the disease runs, it is very difficult to decide whether one is effecting a cure by one method or another. Some of the cases seem to drag on for years and years without any treatment; on the other hand, others metastasize very rapidly and lead to a series of complications. X-ray in some cases seems to benefit these patients, though the evidence is not absolutely clear.

In connection with tumor of the testicle, the evidence seems to be in favor of x-ray treatment of the original tumor prior to operation.

In view of the numerous subjects touched upon by Dr. Bugbee in his paper, it is impossible in a brief discussion to do more than select a few of the high points and comment thereon.

Dr. F. WARNER BISHOP: Dr. Bugbee's clear-cut and concise presentation of a most important phase of urological work represents more than just a scientific paper. To one who may read between the lines there is to be seen the great triumph of modern urology. For there is no branch of medicine or surgery in which diagnostic methods are so highly developed. The instruments used here are truly instruments of precision and the accuracy of the observations is not to be matched in any other specialty with the possible exception of ophthalmology.

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Thanks to the consummate skill of the urologists we poor humans may now have relief from the most painful and dreaded maladies. We now no longer need feel as did Pliny when he wrote, "There are three sorts of diseases to escape which a man has a good title to destroy himself; the worst of which is the stone in the bladder when urine is suppressed." And in this day of cystoscopic enlightenment when a man is "seen to urine black, thick, and frightful water or to have it suppressed by some sharp and craggy stone" he need not fear as did Montaigne in the fifteenth century that operation for the stone would be in a place where the stone was not. Montaigne tells us of "a bishop who was my particular good friend" who underwent the operation. "And when he was dead and opened the stone was not in the bladder but in the kidney."

In discussing Dr. Bugbee's paper there is little I can add, and nothing I can criticize. Perhaps, however, there are a few of his words I can emphasize. Of course, we all realize that elimination of the products of catabolism is the all-important consideration in safe-guarding the post-operative urological patient. And here water is our chief indication. The quantity which may be safely used by the various methods of administration is much under discussion, but I feel that there is little danger of over-loading the circulation by amounts up to 4 or 5000 c.c. per day, so long as we do not introduce more than 1000 directly into the circulation. A few fearless surgeons are now giving 7 or 8000 c.c. a day by slow infusion in cases of shock without apparent damage, but many urological patients are elderly and often have a marked degree of chronic myocarditis and I should be fearful of such heroic hydration.

The lazy or distressed colon throws its load

upon the kidneys. Scrupulous attention to the intestinal elimination is essential after operation. This will mean for a time colon irrigations, enemas, cathartics. But let us, as soon as the emergency is over, try to re-educate the bowel to take up as nearly normal function as possible without the use of drugs which keep up a chronic colitis. This means cooperation on the part of the patient without which the colon remains an absorbing surface for bacteria of all varieties which are hurled through the circulation at the embarrassed kidneys. Let me repeat: stop cathartics as soon as possible. Resort to diet, regular habits, and bland preparations of agar, psyllium seeds, or mineral oil.

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As to postoperative bleeding, I feel that I would like to leave with you one definite conviction. Aside from directed ligation of a vessel or pressure upon it, there is no hemostatic known which is so reliable as direct transfusion of blood. Continued bleeding is the indication. We should not wait for a reduced hemoglobin or red cell count.

The true indications for digitalis are decompensation of the heart with edema and dyspnea and many internists feel that in the absence of these digitalis is useless. This attitude however, is a bit modern and many of us are still old-fashioned enough to think that small doses given daily over long periods are a great help to the chronic cardiac.

And may I add in closing a most important form of treatment for sufferers from chronic disease: every ounce of moral support and comfort that we physicians can give.

Dr. N. P. RATHBUN: Perinephritic abscesses do occur occasionally entirely irrespective of any kidney lesion. There is no reason why we should not have an infection in the perinephric fat resulting from a focal infection in the teeth or tonsils in the same way that we may have a similar infection in one of the bones of the leg. The diagnosis of perinephric abscess is sometimes very difficult. Like Dr. Beer, I have seen some cases with a long history. One patient who came under my care several years ago had been suffering for two years with pain and vague discomfort in one loin and had been studied carefully in several hospitals. There was no elevation of temperature and no leucocytosis but he did have a huge tender mass in his right loin. We finally made a diagnosis of renal tumor and started out to do a transperitoneal abdominal nephrectomy. Fortunately, before getting into the peritoneum we opened into a large cavity, evacuated about a quart of pus and the patient went on to a smooth recovery.

Dr. Bugbee's subject is extremely practical; for the cure of such patients depends as much on the after care as on the skill of the operator. I have often said that though you can teach an interne to take out a prostate or kidney in a short time, it takes not only knowledge but wisdom to understand the proper after care. Many of us have noticed that our private cases do rather better than our ward cases. We attempt to see that the latter do have proper care, but details are left to the care of the internes; whereas our private cases have our personal supervision, and we are rewarded for it.

I will speak on only one or two points of Dr. Bugbee's paper, first, the question of bleeding after prostatectomy. I have not quite the faith in the large tube that Dr. Beer has. Recently I sent a man back to the ward with one of those hairpin arrangements which keep the bladder more widely open than with a large tube. The man left the operating room with no bleeding, but several hours later bled profusely and died despite all that could be done, including packing and transfusion. I use gauze and pack in nearly all cases. One of the things that is very important about packing is the time and manner of its removal. One of the men spoke about a patient dying after the pack was removed. It should be removed very carefully and slowly and if it sticks it should be taken out later and removed gradually if necessary.

I think the resection of the vas is almost absolutely preventive of epididymitis. For the last two or three years I have been doing a vasectomy routinely and I have not had a single case of epididymitis since.

If suprapubic prostatectomy cases are not voiding after two or three weeks, I believe there is still some obstruction and such cases should be cystoscoped. Very often we find a little tab which should be removed by a punch or fulguration. Those that heal slowly are due to some obstruction at the bladder neck.

One of the complications that Dr. Bugbee said nothing about is very important; that is toxic psychosis. Most of these cases are not very serious, and many patients following a prostatectomy have a mild psychosis and get well; but I have seen some very ill, and one or two have died as a result of wear and tear on

the system, and exhaustion. It is a subject about which we have a good deal to learn. I have always thought them perhaps due to some unknown factor, possibly a mild sepsis, or a mild degree of uremia not expressed in the terms by which we usually recognize it. The patient may have normal urea, creatinine, etc., and yet be uremic. Of course in all these patients we have a background of cerebral arteriosclerosis. In many cases there is a mental background, etc. In some instances possibly a lowering of the blood chlorides has something to do with this problem; I have checked that up and found it so in some cases. It is a very mysterious subject and worthy of further study.

The question of lithiasis and the importance of after care: I heartily subscribe to what has been said about proper urinary drainage following the removal of calculi. I believe that cases after the removal of renal calculi should be followed for some time, and treated with irrigations, ureter dilatations, etc., and repeated x-ray pictures.

I also heartily subscribe to what was said about the care of the urinary tract in tuberculosis and the postoperative hygienic care. When we have done a nephrectomy for renal tuberculosis, we have only started the treatment.

Carcinoma of the prostate: In all my cases I do a suprapubic cystotomy, certainly where there is much retention and even where there is very little or none. I think such patients get along very well with their suprapubic tubes, live longer and more comfortably. I also employ radium either through the bladder or through the perineum.

DR. OSWALD S. LOWSLEY: I heartily subscribe to most of what Dr. Bugbee has said. Each of us has his individual preferences in small things, otherwise there would be no individuality or personality. The after care of the prostatic case is a particularly interesting subject. I understand that when a physician discharges a patient who has had a typhoid fever he prescribes a three months' period of convalescence. I think we should likewise, in the average case after prostatectomy, prescribe a six months' period of convalescence. If the patients will take a complete rest for as long a period of recuperation as possible they will make a better ultimate recovery than if they attempt to resume business too soon.

The after care of calculous cases interests us very much. We have had some very interesting experiences. One case of which I have spoken before we have followed for ten years. The patient was entirely relieved of calculi. In the one remaining kidney, by changing the reaction of the urine from alkaline to acid and by keeping it changed the patient has had no recurrence since, whereas she had been operated on five times by me previously and twice before I saw her.

The question of the postoperative care of tuberculous patients is very close to us. We have a clinic devoted to that purpose, and Dr. Rathbun said just what I think, that when the operation is over the work of the surgeon has just begun. We have allied with ourselves Dr. Wang, who is familiar with pulmonary tuberculosis and has been very helpful to us in caring for these chronic urological cases. We hold the clinic twice a week and run parallel cases of patients treated with tuberculin and others treated with only hygienic measures. Drs. Dalzell and Wang are doing excellent work in this clinic.

Concerning Dr. Taylor's presentation: It seems to me that perinephric abscess can present a greater variety of symptoms than any other lesion we meet in urological surgery. I have cases with a history of nine years standing: a woman had her first febrile attack with pain in the side nine years before I saw her. Later she had a similar attack which lasted for some months. The pain was felt in the uppermost part of the right upper flank; she had some lung symptoms also; she then had a third attack two months before she saw us. Investigation showed that the ureter was obstructed at the ureteropelvic junction. On operation we could trace these three different cycles in her history. One palpated a cavity, and as this was explored a diverticulum-like orifice was found above and a cavity extended up under the diaphragm. A great amount of pus was evacuated and then another similar cavity extended below into the pelvis. She had formed a sac and protective wall which broke out on two occasions in two different directions.

Dr. J. S. Read: I wish to pay my tribute to the valuable help received from Dr. Bugbee's paper. In the two-step operation there is an increasing tendency to remove the prostate, nine or ten days after the cystotomy. Within a month I have seen 2 cases, in which there has been severe hematuria and shock, which could have been avoided if a longer period between operations had been allowed. Has Dr. Bugbee any minimum time limit between operations?

Dr. S. R. Woodruff: I was much interested in Dr. Taylor's description of a case of perinephritic abscess, and that he quoted one surgeon as saying that all such conditions were caused by cortical abscess of the kidney. It is difficult for me to believe this. My personal experience with perinephritic abscess is that one sees two varieties. The usual type is the one that comes on so slowly and with such indefinite symptoms that the urologist is not consulted until several weeks have passed. The patients usually have little or no urinary symptoms, and we are called upon for our opinion because of the pain in the back. The urologic work-up of such a condition usually shows an excursion of the kidney from its normal position and its shadow much obscured. The function is frequently delayed, but found normal upon the passage of a catheter to the renal pelvis. Pyelographic study usually reveals the kidney to have been pushed out of its normal position and frequently rotated upon either axis. There is usually no demonstration of kidney involvement in this condition. The other type of perinephritic abscess is associated with a cortical abscess which breaks down and ruptures into the perirenal space. It is usually associated with high temperature, severe pain and more or less toxemia. It is difficult for me to reconcile the statement that a perinephritic abscess is always associated with a renal abscess because in my own experience where I am unable by the ordinary urologic study to determine renal involvement, and at operation large perinephritic abscess is found, I am content simply to open the abscess cavity and supply adequate drainage. Unless one delivers the kidney for actual inspection, I do not see how the presence or absence of a renal abscess could be proved, and my personal judgment is that such a procedure is somewhat unjustifiable in the presence of a large abscess.

Dr. Bugbee's paper is of great value. We all need to check ourselves up on operative and postoperative work. I find the postoperative treatment varies to no great degree amongst urologists of today. In the two-stage prostatectomy, actual visualization of the prostatic bed is nearly impossible, and I have employed

for some time direct pressure with a mass of gauze held by the fingers of one hand, and pushed into the bleeding area from which the prostate has been removed. As in practically all two-stage operations one or more fingers are inserted in the rectum to lift the prostate up for better enucleation, direct counter pressure can be made against the rectal fingers and bleeding by this means usually controlled.

Dr. John A. Taylor: After a review of the literature one is almost forced to conclude that perinephritic abscesses come from cortical lesions in the kidney. The largest series of cases has been reported from the Mayo Clinic. Braash reported 67 cases in 1915, followed in 1924 by Dr. Hunt, who reported 59 cases; and Habein reported over 14 more in 1928, making a large series of cases of perinephritic abscesses. These cases were all reported with the idea in mind that perinephritic abscesses come from cortical abscesses. The most convincing was Dr. Hunt's article in 1924—106 cases; of these, 59 were the so-called perinephritic cases; 28 of these were explored at the time of operation; 5 had nephrectomy; these 33 cases, all that were able to be investigated, all had cortical lesions in the kidney on the affected side. It does seem to me from an etiological standpoint that the logical path of infection is through the kidney, for the kidneys are the sewers of the body that would try to throw off foreign bodies from the blood stream. It seems more logical for abscesses to form, following perinephritic abscesses, in

the renal cortex than it does that they should form in the avascular fatty renal capsule.

Dr. Henry G. Bugbee (closing): As for the case of the single kidney with tuberculosis: the woman had typical tuberculous lesions in the bladder, had no left kidney; the urine from the single kidney contained a large amount of pus with many tubercle bacilli. The pyelogram also showed the characteristic necrosis of tuberculosis. She had tubercle bacilli in the urine for four years, but for the last ten years, the urine has shown no tubercle bacilli. I believe that when tuberculosis of the kidney is diagnosed and a healthy kidney is revealed on the other side, the diseased kidney should be removed. In this case, however, one sees the possible reparative power of the body. A pyelogram taken seven years ago showed considerable destruction of kidney tissue, but the areas of necrosis were well walled off.

Dr. Rathbun spoke of postoperative psychosis. I have noted this as a rare postoperative complication, and it is a distressing one. I have always thought it to be due to a combination of uremia, poor circulation, and sepsis.

Dr. Read asked about the length of time allowed to elapse between cystotomy and prostatectomy. The second operation is not carried out in less than two weeks after the primary cystotomy. The exact length of time between the two operations varies with the individual case; the longer the interval, the less pronounced will be the reaction following the prostatectomy.



PROSTATIC HYPERTROPHY*

ITS SURGICAL TREATMENT

ROBERT E. DAVISON, M.D.

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THOMPSON states that of men who have reached sixty years of age, 34 per cent have enlarged prostates but only 16 to 17 per cent of the whole are affected by symptoms. So about half of the enlarged prostates give symptoms. The prostate is purely a sexual organ and likely passive regarding urination; however, the symptoms of prostatic disease are predominantly urinary.

The cause of hypertrophy is unknown. Most writers agree that the enlargement is due to fibroadenomata much like those found in the mammary gland. The cause of fibroadenomata wherever found is unknown.

The family doctor sees these cases first. An old friend perhaps whom he has attended with his wife and children for years comes to him for counsel. He states his urinary trouble in a hesitating manner rather ashamed to confess that he must be growing old. The family physician holds a very important position as to the future of this man's life. If his advice is good he will carry him over this serious urinary event to future good health; but, if on the other hand, his advice is wrong he may lead him into a miserable existence, and eventually death from pyelonephritis.

The advice to the prostatic should always be surgical treatment. There is no other treatment worthy of consideration. The so-called catheter treatment is always lethal. When I look back over more than twenty years of surgery there is no class of patients more grateful to me than my old prostatics, and no operation has given me more satisfaction than that of prostatectomy.

In this paper we shall consider only simple prostatic hypertrophy, i.e., the adenomatous type of hypertrophy.

The prostate is located in the neck of the bladder partly urethral and partly intravesical. It may be described as the shape and size of a large horse-chestnut with the apex in the urethra and the base in the bladder. The urethra and the ejaculatory ducts perforate the prostate. The important Denonvillier's fascia separates it from the rectum posteriorly and extending anteriorly forms the puboprostatic ligaments. Besides this sheath it has a definite thin capsule of fibrous tissue which dips into the parenchyma, forming lobules. The parenchyma is composed of glands of the compound racemose type with a stroma of non-striated muscle tissue. The secretion is poured into the lateral portion of the floor of the prostatic urethra. The prostrate has two lobes known as the right lobe and the left lobe. These lobes are not distinct excepting in hypertrophy. The pathologic middle lobe originates in the glands of Albarran in the floor of the prostatic urethra. The hypertrophy is due to fibroadenomata growing within the gland. Surrounding the fibroadenomata is a false capsule of normal prostatic glandular tissue. The word prostatectomy is a misnomer because the entire prostate is not removed. The only portion removed is the pathologic fibroadenomata. An adenectomy within the bladder would more properly describe the operation. This is why sexual function is rarely impaired by prostatectomy. There should be always enough normal prostatic gland left behind to function adequately.

The prostate lies on the rectum and is readily accessible to palpation by the finger. It is very rich in blood supply, and thereby accentuates hemorrhage as being a possible complication in prostatectomy. As a matter of fact hemorrhage

^{*} Read at a meeting of the Crawford County, Pa., Medical Society, Oct. 15, 1930.

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Arterial bleeding is usually caused by the incision in the capsule; therefore with a good exposure the spurting artery may be caught in a hemostatic forceps quite readily and tied. Venous hemorrhage can be controlled by packing because of the low blood pressure in the veins; consequently to be free of serious hemorrhage demands delicate and skillful surgery. If the surgeon keeps within the false capsule during the enucleation of the adenomata bleeding will not be excessive. Fatal postoperative hemorrhage is possibly always caused by rough handling during the enucleation, thereby lacerating the prostatic plexus.

The symptoms of prostatic hypertrophy vary much with each individual. It would take much space, indeed, to record all the symptoms referable to this affection; however, this is not feasible in this paper, nor is it essential.

Keyes notes briefly a triad of common symptoms that are almost pathognomonic, which will do quite well for a working outline, namely: (1) frequency of urination, chiefly by night, (2) difficulty in urination and (3) dribbling from overflow, or irritation of the bladder.

There is usually nocturnal polyuria with frequency and as the night wanes the frequency is increased. The night's

rest is very much disturbed. Urination becomes difficult, the stream is slow to start, the flow lacks force and there is no gush at the end of urination. The urine dribbles and drops. If the patient gets wet or cold or bathes in cold water, or is indiscrete in diet, he may not be able to void at all. He suffers from acute retention. Dribbling is a source of great discomfort. Of all the symptoms this one is the worst. It may be due to overflow from the chronic retention or simply irritability of the bladder. The prostatic may pass slight amounts of blood at the end of micturition. The early irritability of the hypertrophied prostate may lead to priapism, to a return of the morning erection, and also, to moral obliquity. Epididymitis, cystitis, pyelonephritis and vesical stone may complicate prostatic hypertrophy.

The commonest cause of prostatic disease in a man over forty-five years is prostatic hypertrophy. When a patient, aged forty-five or more consults a physician with a history of Keyes' triad of symptoms he should suspect hypertrophy of the prostate.

The first step of the examination is palpation of the prostate through the rectum. This at once may confirm his first impression. He will fail if only there is a median lobe enlargement, otherwise he will gain a very good idea of the prostate.

Secondly, he will palpate the hypogastrium for a full bladder. It is well for him to replace the finger in the rectum and palpate between the two hands. Then he will have the patient void in a glass. This will give him information as to the difficulty of urination and as to the flow of the stream. This urine should be chemically and microscopically examined. It is best to send the urine to a laboratory equipped for complete urinary tests.

The patient then should lie down to have a catheter passed. It is best to use a small size, linen catheter with a Coudé' tip. The amount of residual urine is measured, the atony of the bladder determined, length of the urethra, etc. The physician will gain a great deal of information. The catheterized specimen should also be sent to the laboratory. If the bladder should contain a pint or more residual, it is wise when the bladder is irrigated to leave in the bladder at least half as much solution as urine drawn out. Some very bad results have followed rapid decompression of a highly distended bladder.

Cystoscopy should only be done by a trained man in this work. We never cystoscope these patients outside of the hospital. When you have gathered your data you should be able to diagnose the case at least tentatively as one of prostatic hypertrophy

requiring surgical relief.

This examination will about exhaust the average physician's training in genitourinary surgery. Of course, the expert urologist will readily differentiate simple hypertrophy from other prostatic pathology by methods not within the scope of this paper.

Cases of acute retention complicating prostatic hypertrophy are usually seen first by the family physician, or some other physician living in the neighborhood. These calls are not infrequent and every family physician should be equipped with the instruments to take care of these old men properly. Metal catheters should be tabooed. A good linen catheter No. 18 F. with a Coudé tip, and also, a Phillip's linen catheter with filiform attachment will be sufficient to relieve all cases of acute retention due to prostatic hypertrophy. Surgical removal of the enlarged prostate should be urgently advised.

The preoperative preparation is most important and may determine success or failure of the prostatectomy. These patients are usually in the evening of their lives, therefore senility probably participates in every function. The surgeon must not only be a good operator but he must also be a good physician.

On the admission of the patient to the hospital a general physical examination is made. The cardiovascular system is

carefully measured and considered. The hypertensive cases have an eyeground examination by an oculist. A blood count, urinalysis daily, and phthalein test are made; also blood chemistry for nonprotein nitrogen and sugar. It is surprising how frequently we find a hyper-glycemia where least expected. The patient is given 8 pints of water daily and the output measured. Many of these cases require digitalis. After a forty-eight hour rest in the hospital the bladder is examined with a cystoscope to complete the diagnosis and later, perhaps the same day, a cystotomy under regional anesthesia is performed.

The bladder is filled with normal salt solution, and then opened and carefully palpated for stones. If stones are present they are removed. Two silver wire sutures for coaptation are placed through all the tissues including the bladder walls. A large Pezzer catheter 40 F. in size is inserted for suprapubic drainage of the bladder and the incision closed with the wire sutures. These wires are left long and the ends covered with adhesive plaster so that they will not catch on the dressings.

The second step of the operation, or the actual prostatectomy, is done when the surgeon believes the patient can stand it. We have found it to be helpful to have a good medical practitioner associated with us in the surgical treatment of these cases.

The phthalein output usually increases under drainage and the non-protein nitrogen comes down. We like the non-protein nitrogen to be below 40 mg. per 100 c.c. of blood before operation. If the nonprotein nitrogen remains high we do not operate. Sometimes the patient cannot, or will not, take the required amount of water. In this case we pass a duodenal tube at 9 o'clock in the morning and leave it in the duodenum until 12 noon, in the meantime giving the necessary amount of fluid, 8 pints, through the tube. This is done daily. It is rarely we are compelled to do this. We routinely give 30 grains of hexamethylenamine in a tumbler of water

in the morning and 30 grains of triple bromides in the evening. The diet depends entirely on the conditions found. The patient is allowed to sit up at will. The bladder is flushed with boric acid solution through the Pezzer drainage tube daily. The average preoperative preparation is fourteen days. So far every patient referred to us has been operated on. That means that all of them had responded sufficiently well to the preoperative preparation, that we were able to do the prostatectomy. It does not mean, of course, that we had cured his extrinsic pathology before operation. Since we have stopped using inhalation anesthesia we have observed that patients suffering from hypertension, or emphysema or cardiovascular diseases do very much better. Our greatest problem is kidney dysfunction due to pylonephritis.

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Two hours before the operation the patient is given 6 grains of sodium amytal by mouth. We use caudal and trans-sacral anesthesia with regional anesthesia in the suprapubic region, or we may use a low spinal of 100 mg. of neocaine in the third lumbar spinal interspace. Lately we have been using more spinal anesthesia.

The bladder is flushed through the Pezzer catheter with warm boric acid solution, and the catheter and silver wires removed. The suprapubic opening is enlarged and a self-retaining bladder retractor inserted. This gives a good exposure of the operative field. A soft rubber catheter is passed into the bladder through the urethra and connected with an irrigator.

The bladder is once more flushed with warm boric acid solution from the irrigator and at frequent intervals during the operation. The operator puts a glove on the left hand and none on the right hand. The left hand is placed in the rectum with fingers pressing on the prostate. With his right hand in the bladder he pushes his index finger into the urethra and splits the mucous membrane with his finger nail posteriorly. He then shells out the prostate using the index and middle fingers. The fingers in the rectum are very

important because they steady the prostate and give the operator a proper sense of thickness of tissues, and also, aid in the completeness of the operation. No cutting instruments of any kind are used in the enucleation of the fibro-adenomata.

After the prostate is thoroughly loosened it is caught by Young's prostatic forceps and removed from the bladder. The prostate may be removed in one piece but usually it is in several pieces. The operator should be careful to loosen every part of the prostate with his fingers before much traction is put on the prostatic forceps. The hand has remained in the rectum all this time, and once more the prostatic capsule is palpated with the right hand to remove any small pieces of the adenomata left behind. The bladder is flushed with borid acid solution quite warm, 110°F., and any spurting arteries are caught in hemostats and tied with catgut by the assistant. To stop the venous bleeding the capsule is tightly packed with iodoform gauze in one long strip 2 in. wide. The gauze extends out through the wound. Now the finger is removed from the rectum, the glove removed from the left hand, the hands cleansed and fresh gloves put on. Inspection of the bladder is made for bleeding and closure begun. The upper part of the bladder incision is closed with a running suture of fine catgut. The fascia is brought together about halfway down with chromic gut and the skin for a like distance with silkworm gut. Two silver wire sutures are placed as described in cystotomy and are loosely brought together. A final irrigation is done and the urethral catheter removed. Large dressings are applied and the patient returned to a warm bed.

In the postoperative treatment it is important to keep the patient quiet and comfortable. Morphine is usually required during the first twenty-four hours. We continue the hexamethylenamine and triple bromides as we did in the preoperative preparation. We continue the water in large quantities, i.e., 128 oz. in twenty-four

hours. We give fluids by vein as we do in other surgical postoperative cases. We may give normal saline by hypodermoclysis the first day; after that we give plain water by mouth or through the duodenal tube. The gauze packing in the bladder is removed within seventy-two hours, and a large Pezzer catheter is inserted in the bladder and connected up with a drainage bottle. The silver wires are drawn up tightly around the drainage tube. After the gauze packing is removed and the suprapubic drainage tube placed, the urine is all carried off into the bottle, and there is practically no leakage. We try to get the patient out of bed on the third day; thereafter, he sits up a part of each day. The bladder is flushed daily through the drainage tube with a mild mercurochrome solution. The silkworm gut sutures are removed on the eighth day.

About the fourteenth day a large urethral catheter is passed and fixed

to the penis by adhesive tape and connected up with a drainage bottle. The suprapubic drainage tube is removed and the wound drawn tightly together with the silver wire sutures. The bladder is still being flushed daily. About the twenty-first day when the suprapubic incision is healed the permanent catheter is removed, and then passed once daily to flush the bladder. All sutures are removed from the suprapubic wound and usually by the twenty-eighth day the patient is healed, voiding rather frequently and ready to go home.

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The follow-up treatment should be continued for about one year after the operation. This we believe to be important. Weekly, or later bi-weekly, bladder irrigations and an occasional urethral dilatation with a metal sound of large caliber improve the results of the operation very much.



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^{*}Continued from p. 14.

THE SEXUAL FACTOR IN PROSTATIC HYPERTROPHY*

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THUS far, all theories which have sought to explain the causation of benign hypertrophy of the prostate have proved to be unsatisfactory. None of the theories have been founded on sufficient data to enable them to account but for a very small number of cases. Schools of thought which seemed almost irrefutable yesterday and were generally acclaimed, today have been disproved and discarded. Though our technique for the surgical removal of the prostate has reached a high degree of perfection, yet little advance has been made in recognizing the cause of the malady or a means of preventing it.

One very significant contribution to the problem of prostatic hypertrophy was made by Kenneth Walker in 1922 in a paper entitled "Nature and Cause of Old-Age Enlargement of The Prostate." In this article, he presents a panoramic view of the prostatic problem and calls attention in particular to the variation in the incidence rate of prostatic hypertrophy among the various races. He points to the rarity of the malady among certain people and seeks to ascertain the reason. If prostatic growth is a disease of the white man what is there in his mode of living that is conducive to it?

The survey of Walker and corroborated by that of Pfister, indicates that prostatic enlargement is less common amongst the inhabitants of Japan, China, Philippines, Egypt and Africa. Here are some of the important facts as elicited by the questionnaire sent by Walker to surgeons of the various races. India: Prostatic enlargement less common than in England. Japan: Prostatic enlargement is very rare. Dr. Matsumato reports that in the records of the out-patients' department of the special Hospital for Urinary Diseases at the University of Kyoto there is an average of 4 cases of enlarged prostate per annum, although the total attendance runs into

several thousands. Prof. Hyami of the same university has never encountered the condition on the dissecting table. Kitagawa and Takagi also youch for the rarity of the condition. China: Dr. Koch, of the Government Hospital at Hong Kong, states that during the last fourteen years, no case of enlargement has been seen, although the yearly average of in-patients is 4000, and of out-patients 25,000. In the Canton Hospital records for the years 1915, 1916 and 1919, there are 3 entries of prostatic enlargement, although during the same period as many as 156 cases of vesical calculus are recorded. During the years 1910 to 1919, 13,761 operations were performed in this hospital, of which 6 were prostatectomies. Egypt: Not uncommon but less so than in England. At the Kasr-el-Ainy Hospital, Cairo, there were 17 cases of prostatic enlargement in 1921 out of a total of 8472 male in-patients. Pfister, who for many years was a physician in the Deaconess Hospital in Cairo, was impressed by the rarity of the condition in Egypt and believes that it is all the more remarkable because infection of the bladder and prostate by bilharzia is rather common in this country. Milton, Goebel, Kartubis, Madden and Legrand have made similar notations. Philippines: J. M. R. Dill writes, "Has hypertrophy of the prostate ever been observed in old people here in this country? Certainly never in the great number of patients in the Philippines General Hospital in Manila." South Africa: Medical men are of the unanimous opinion that enlargement is extremely rare amongst the natives of South Africa. It must, however, be taken into consideration that few natives live beyond the age of fifty. North America: The incidence amongst the white is similar to that of England but the affection is rather rare amongst the negroes. Of course the question immediately arises, "Is the comparison fair?" In all likeli-

* From the Department of Urology, University of Illinois. Submitted for publication July 28, 1930.

hood the average negro does not live as long as the average white, and the negro thus afflicted does not seek medical aid as readily as the white. Nevertheless, the majority of American urologists agree that the condition is rare amongst the negroes. As a result of this study Walker believes that prostatic enlargement has an anthropological distribution and according to frequency classes the races thus: Caucasian, Semitic, Arabic, Indian, Mongolian and Negroid.

Now those countries in which prostatic enlargement is rare, are the very places in which the sexual life is rather unrestricted. This then disproves the theories once held that sexual excesses or attacks of gonorrhea predisposed to prostatic enlargement, for those races which are comparatively free of the condition are the very races not known for their continence. What then, is there about the sexual life of the Caucasian which predisposes him to prostatic hypertrophy? Is this form of tumor the price he pays for so-called higher morality? Why should the celibate clergy escape it? Why should married men be particularly subject to it? What is the relation between the sexual life and prostatic overgrowth? These and other questions germane to the matter need to be answered, and it will be only by a proper piecing together of our many bits of fragmentary knowledge that we ever will, in all likelihood, be able to solve this perplexing riddle.

When a man enters the fourth decade of life he is encroaching on the prostatic danger zone, for it is during this period that the prostate begins to trouble the male sex. Why should the male at this critical period, the old age of youth, begin to manifest prostatic disorder? Now, it has been rather conclusively shown that the indiscretions of youth bear no definite relationship to the formation of prostatic tumor for many prostatics have never had gonorrhea and most gonorrhoics are never bothered with an enlarged prostate. In fact, many urologists are of the opinion that a severe gonorrheal infection is

inclined to render a man immune from prostatic overgrowth. It is then not man's past which rises up to admonish him for his earlier misgivings, it is he who possesses a large boggy prostate who becomes the candidate for prostatism and perhaps ultimately for its surgical removal.

Every urologist knows that if a man leads a normal sexual existence and then suddenly ceases to have indulgence, his prostate will become congested, frequently giving rise to urinary disorders. When such a case presents itself, we find on rectal examination a large tender prostate. On massaging of such a prostate, we can usually express a copious quantity of prostatic secretion together with the products of inflammation. Relief of symptoms and reduction in size attend such an artificial evacuation and therefore we logically assume that when such cases are medically managed there is little likelihood of a surgical prostate developing. Recently Ballenger, Elder and McDonald have reported a very significant observation in the matter of preventing benign enlargement of the prostate. They noted in their practice that there were no cases of prostatic hypertrophy occurring among their patients who were periodically masaged. The group included males between the ages of forty and sixty-five. They reason, and I believe rightly so, that a mild irritating toxin produces the hyperplasia and that by massage the toxin is eliminated. Van Lackum and Mitchell were also able to obtain excellent results in the so-called bar obstructions, by routine massage, instillation and dilatation.

Prostates become disordered during the period of the male sexual crisis, unless they are unloaded of their contents either in a physiological or mechanical manner. The process is somewhat as follows: The gland normally secretes a substance essential for activating the spermatoza. During sexual excitement the muscular tissue of the prostate contracts and forces this secretion into the urethra. Now when there is a sudden abatement of sexual activity, the prostate becomes congested

and swells because there is an accumulation of secretion. And so, even though a man may feel that he may safely abstain from sexual activity, physiologically he cannot and the penalty for his defiance of the natural law is prostatic trouble. Beer has stated, "The etiology of prostatic adenoma is not understood, but it would seem that the irritation associated with sex activity whether gratified or not, may underlie the condition."

We do know that a goodly number of men radically alter their sexual conduct on entering the middle span of life and practice sexual abstinence. The underlying motive is not always ascertainable. Some men feel that a celibate existence constitutes the ideal life; others that sex is something the sensible man should put out of his life after he has entered the years of discretion. Not a few men think that by foregoing sexual activity they will conserve their energy, that sickness will not befall them and longevity is thereby assured. A continent life is forced on many men because their spouses are ill or frigid, or their libido may be inhibited by financial or business worries or psychic impotency. Cases such as fall within this category are very apt to manifest the urinary symptoms associated with an inflamed prostate and unless their prostate is depleted by massage or an equivalent measure, the gland will continue to gradually enlarge and cause its customary phenomena. Though we no longer consider Ciechanowski's view that hypertrophy is a sequelae to gonorrheal prostatitis, we cannot deny that the inflammatory process does play a part in initiating the proliferation of the glandular elements.

I have previously called attention to the statement made by Young that the celibatic clergy are practically immune to prostatic hypertrophy. In this group the prostate never develops into an actively secreting gland because at a very early age the sexual life was abnegated and the prostate accordingly was never called into activity as it is in the normal married man. Celibacy adopted late in life is therefore

not a preventative but rather an accelerative of prostatic enlargement.

Dovetailing perfectly with our foregoing data is the work of M. Roth, Director of the Pathological Institute at the University of Basel, who has carried out a pathological and histological investigative study of 300 prostates in men varying from thirty-six to ninety years. He found some evidence of prostatic hypertrophy in 101 cases (approximately 30 per cent) and this was exclusive of inflammations and malignancies. His findings are as follows:

		Prostatic Hypertrophy	
Years	Cases	Per Cent	
36-40	<i>5</i> I	7 or 13	
40-50	91	23 or 25	
30 - 60	64	20 or 31	
60-70	55	31 or 56	
70-80	28	14 or 50	
80-00	1.1	6 or 54	

Of course it is not to be inferred that a man with a small spheroid in his prostate at forty is ever going to manifest gross hypertrophy of the gland any more than a small fibroid in a uterus will of necessity develop into a large one. But, I do wish to emphasize the point that prostatic tumors do not spring suddenly into existence during the fifth and sixth decade. Prostatic hypertrophy has its incipiency between forty and fifty and only becomes bothersome when certain conditions either in the sexual life or in the endocrine system promote the formation of spheroids.

SUMMARY

It is the intent of this study to explain the frequency of prostatic hypertrophy amongst the Caucasian race. I do not believe the difference lies in an anthropological or geographical basis, but rather in the main because of our cultural code which tends to repress the natural outlet of sexual energy. Prostatic congestion is the price often paid for ignorance regarding the physiology of the sexual organs. The most logical method of preventing prostatic hypertrophy is periodic massage of the congested prostate or a vita sexualis which is compatible with the age, inclination and general welfare of the patient.

[For References, see p. 55.]

MANAGEMENT OF PATIENTS SUFFERING FROM PROSTATIC OBSTRUCTION*

F. D. LAROCHELLE, M.D.

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THE last twenty-five years have seen a most gratifying progress in the management of prostatics. Two decades ago patients who were admitted to the best hospitals because of acute retention due to prostatic obstruction could be given little more than a choice between early death, or lingering to endure almost ceaseless suffering. The surgeons and the procedures characterizing the period of time which has since intervened are striking examples of the wonderful progress made.

There are today three recognized methods of approach to the prostatic problem. To these we wish to add a fourth. (1) A one-stage suprapubic enucleation may be done, after preliminary drainage via the urethra; (2) a two-stage suprapubic prostatectomy may be carried out after cystotomy; (3) the gland may be removed by the perineal route, with a one-stage procedure, drainage being maintained by the perineum.

The objection to the first listed, the one-stage suprapubic method, is the high mortality rate which attends it. While accurate reports regarding all such operations would be impossible to obtain, it seems likely that the mortality reaches as much as 25 per cent. By the employment of preliminary drainage through a cystotomy opening, this rate can readily be reduced to 10 per cent. Another drawback to this procedure is the time it requires for complete recovery. The perineal operation gives good results in much less time and cuts the mortality rate in half, or even lower, if performed by skilful hands. But on the other hand, the perineal operation is a more difficult surgical feat, and the epididymitis and fistulae which sometimes follow, are exceedingly distressing sequelae.

It is our intention to describe a two-stage

perineal method offering advantages found in no other of these procedures.

Selection of Patients: This operation is so benign that a man fit to undergo any major surgical procedure can by its employment be relieved of a most distressing condition, without incurring undue risk.

Preliminary Management: Patients with enlarged prostate usually enter the hospital only after acute retention has taken place. It is our practice to give sodium amytal immediately, in doses sufficient to relieve suffering. A very gentle attempt to pass a soft rubber catheter is then made. If this fails a cystotomy is done at once under local anesthesia. At the same time the bladder is explored and the configuration of the prostate noted. If a loose stone chances to be present it is removed. A 32-French Pezzer catheter is sutured in the bladder, the wound irrigated with 1:5000 metaphen solution and closed without drainage. The urine is kept antiseptic by the administration of suitable doses of pyridium, thus obviating the disagreeable odors often given off after cystotomy has been done. The bladder is irrigated several times a day with the 1:5000 metaphen solution.

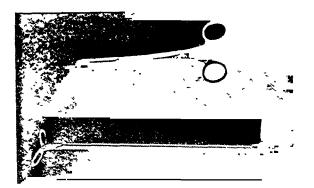
After ten days to two weeks of such preliminary medical attention, observing all the necessary precautions, we remove the prostate by the perineal route. The cystotomy tube is not disturbed and the bladder is not drained by way of the perineum.

Anesthesia: Spinal anesthesia with sodium amytal base has proved very efficient in our work. The dosage of spinal anesthesia is so small that any chance of untoward effects is done away with, and it induces an ideal relaxation.

escribe a two-stage Technique: The patient is placed in the *Submitted for publication December 16, 1930.

lithotomy position and the perineum elevated. No special table is necessary. Several sounds are employed to dilate

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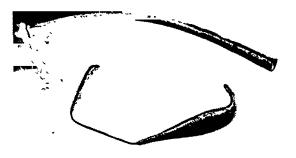


Fig. 1. A. Proust retractor. B. Pezzer catheter. C. Crowell tractor. p. Vacher clamp.

the prostatic urethra, and a Crowell tractor passed into the bladder. This retractor has so reduced the difficulties of this operation that it must be listed as one of the major contributions to the advance in treating prostatic conditions.

After the prostate has been pulled down forcibly in the perineum and the scrotum pulled up over the abdomen, an inverted-v incision is made. The incision must not be placed as low as is usually directed in textbooks. The prostatic and membranous sections of the male urethra correspond to the entire urethra of the female, having the same embryological origin. The duct hugs the under part of the pubic arch. It is as inexpedient to make a low incision for exposure of the membranous urethra in a man, as it would be to cut into the perineum to locate the urethra in a woman. If the incision is made high and parallel to the pubic arch no retractor at the apex of the incision is necessary.

The areolar tissue is next incised laterally and the prostate located by the fingers placed on either side. Once this is accomplished the central tendon is exposed by two fingers acting as lateral tractors. The tendon is carefully cut until the rectourethralis muscle can be brought into view and so severed. A Proust retractor then replaces the fingers and the fascia is dissected off the prostate until the membranous urethra can be seen, together with the apex and lobes of the prostate.

At this stage the operator must orient himself very carefully before proceeding further. With ordinary care the rectum should suffer no injury. Should it be accidentally opened, however, the fact that there is no vesical drainage through the perineum, greatly diminishes the importance of the mishap.

Once the prostate is exposed and the tractor felt in the urethra, an inverted-v incision is made deep into the tissues of the gland. The blade of the scalpel should open the prostatic urethra and expose the tractor. The flap is then pulled down. It contains the prostatic capsule with compressed prostatic tissue, the floor of the prostatic urethra, and the opening of the ejaculatory ducts. Extreme care should be exercised in handling both flap and urethra.

The procedure just described is usually referred to as a prostatectomy, but this is, of course, not strictly accurate. No attempt is made to remove any normal prostatic tissue. By blunt dissection the adenomatous masses around the prostatic urethra are exposed and removed, with the use of a Vacher clamp. We know of no substitute for this valuable forceps. When the neoplastic masses are all cleared away the flap is replaced and sutured in position. The central tendon is then repaired, a small gauze drain placed in one fossa, and a tube, 1/4 in. in diameter, with several eyes, placed in the other. The tube is sutured to the skin. The bladder and the perineal wound are irrigated with the metaphen solution and the skin wound

closed with clips. Upon removal of the urethral tractor the operation is completed.

After-care: Pyridium is administered to the patient. The bladder and perineal wound are irrigated regularly, at first hourly, then at gradually extended intervals. There should be no suppuration in either wound, and consequently epididymitis does not develop, rendering preliminary vasotomy superfluous. The gauze drain is removed after twenty-four hours, the perineal tube after a week. The wound is then irrigated by means of a little tube

attached to a Luer syringe. As a rule little or no urine drains by the perineum and the wounds heal in a couple of weeks. The patient may get up on the first or second day after operation and on the third begin taking two tub baths a day. These are very invigorating, and keep the perineal and scrotal regions clean. As soon as the perineal wound heals, the cystotomy tube is removed, so that the patient gets around comfortably. All wounds should be healed and the patient urinating naturally within a month from the time of operation.



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* Continued from p. 8.

EXPOSURE OF THE BLADDER AS A STEP PRELIMINARY TO CYSTOSTOMY, PROSTATECTOMY AND LITHOTOMY*

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TILLIAMS,1 in 1916, described a two-stage cystostomy and strongly advocated its use in the poor risk prostatic and the average patient requiring lithotomy for vesical calculus. The aim of his technique was to prevent gross infection of the suprapubic wound with its attendant dangers and discomforts. Briefly, his method was to expose the bladder in the usual manner, place stay sutures in the bladder wall, pack the wound open with gauze and enter the bladder some four to seven days later. After this interval an aseptic inflamamtory reaction had matted together the component layers of the abdominal wall, sealed off the paravesical tissues and converted the wound into a cleanly granulating trough. The net result was an effective barrier against a dissecting infection. With this operative sequence, prostatectomy became a. three-stage affair.

The basic principle here is one utilized fairly frequently in general surgery. Resection of the larynx and excision of an esophageal diverticulum in two steps to lessen the likelihood of a mediastinitis, for example, have the same rationale. The application of this principle to surgery of the bladder and prostate I had never seen suggested prior to Williams' article.

In 1927 I² reported to the Urological Section of the Southern Medical Association my happy experience with the method in some 35 or 40 cases during the preceding ten years and stated, in conclusion, that it had secured a very decided alleviation of wound morbidity both in prostatectomies

Williams, H. The technic of suprapubic cystostomy in badly infected cases. Ann. Surg., 63: 686, 1916.

and lithotomies. Keyes³ gave quite enthusiastic support to the procedure, which he termed prevesical section, in a paper read before the American Urological Association in 1929. While his use of the method had been limited to prostatectomies and lithotomies, he suggested application of the technique to resection and to total cystectomy by an original wider denudation of the bladder. I do not know of any other literature on the subject.

The present paper is based upon a group of 97 additional cases in which the exposure technique has been employed since my first report. The urological diagnoses for the series are shown in Table 1. The

average age of the patients was sixty-seven years. Two were under fifty, 22 between fifty and sixty, 38 between sixty-one and seventy, and 35 were seventy-one and over. The pus content of the urine was four plus in over 50 per cent of the group. Table 11 lists the operations performed. The first stage of each operation was, of course, the bladder exposure.

In reviewing our records from 1917 to 1927, I found that 15 or 20 per cent of our one-stage prostatectomies, lithotomies and cystostomies had shown infection to the

³ Keyes, E. L. Pelvic cellulitis following suprapubic cystostomy and its prevention by prevesical section. *J. Urol.*, 23: 119, 1930.

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^{*} Read by invitation before the New York Branch of the American Urological Association, December 4, 1930.

extent of some fascial sloughing. The frequency of infection had naturally been higher for the prostatectomies and lithotomies than for the cystostomies. In order

TABLE II **OPERATIONS** Prostatectomy, three-stage..... 43 Prostatectomy, two-stage..... Cystostomy, two-stage, final...... Cystostomy, two-stage, pre-prostatectomy..... 43 Lithotomy, two-stage, pre-prostatec-6 tomy..... Lithotomy, two-stage, final...... Excision cancer bladder, radium, two-stage..... Diverticulectomy and prostatectomy, two-stage..... 145

to minimize infection, such preventive tricks as having the drainage tube emerge high and the inclusion of the bladder wall in the sutures closing the lower angle of the wound had been adopted in practically all cases; for many, additional sutures had anchored the bladder to the rectus muscles at several points. While in no instance was there a pelvic cellulitis, if one means by this suppuration anterior and lateral to the bladder deep behind the pubis, an occasional patient had developed a very serious infection of the wound characterized by brawny induration, ulceration and dusky discoloration of the skin margins, continued sloughing of fascia, these proconvalescence materially and imposing a burden that the patient could ill afford to carry. The fact that the patient had been rated as a good risk or had a relatively clean urine, had proved no guarantee against such an occurrence.

The same favorable contrast has been afforded in operations immediately following the preliminary exposure for the present series as had been observed for the former one. Without exception there has been no brawny induration about the wound, no discoloration of the skin, no sloughing of fascia, and a notable absence of pain and tenderness. I do not wish to give the impression that these wounds have healed by first intention. This has been true for only 7 of

the 97 cases. But the infection has usually remained superficial and at the worst, with one exception, has confined itself to the granulating gutter. In a single instance, two suppurating tracts have led into the subcutaneous fat for about an inch, obviously following the path of sutures placed at the second operation. In fact, such infection as has occurred has centered about the secondarily placed sutures.

The rapidity with which the fistula closes is possibly some measure of wound health, so to speak, after prostatectomy. For my previous paper, a comparison of two unselected series of 25 prostatectomies handled essentially alike save for the employment or non-employment of preliminary exposure, i.e., one-stage prostatectomies against prostatectomies preceded only by exposure, revealed the average time for closure of the fistula had been decidedly lower in the exposure group. In the two-stage prostatectomies of the present series, the fistula has been solid in three weeks or less for 52 per cent, in four weeks or less for 87 per cent.

The kindly healing after lithotomy is well typified by the result for the stone case of the series which put the method to the severest test. This patient, a prostatic, had seventeen large stones and a foully purulent urine. At no time did this wound have more reaction about it than one frequently gets about a hernia incision. His maximum postoperative temperature was 101°F.

My technique for the exposure has undergone certain changes with increasing experience. The well filled bladder is approached under local anesthesia. The peritoneum and fat are dissected away from the bladder with a knife. The amount of bladder wall exposed naturally varies according to the operation that is to follow. Three guy sutures of fine silk are placed in the bladder wall, one just below the peritoneal reflection and one to each side of the midline at a lower level. Formerly the wound was then packed open with gauze. Now, before putting in the gauze pack, I place temporary double sutures of silkworm gut or heavy silk through muscle and fascia, one or more of them including a bite of the bladder wall. Superimposed sutures go through fascia and subcutaneous tissue. These are left

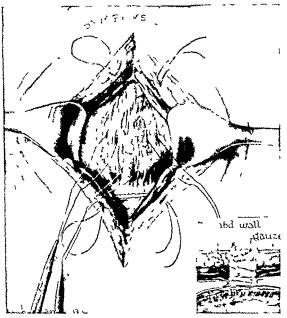


Fig. 1. Customary positions of guy sutures and two of the temporary loop sutures. Superimposed loop sutures through fascia and subcutaneous tissue and untied permanent skin sutures have been omitted to avoid a confusion of suture ends. Insert A shows cross section of wound containing gauze pack.

untied. The loop ends will be used some four or five days later to pull through the permanent sutures. This refinement secures the same aseptic reaction about each suture tract as occurs in the main wound gutter. In the absence of this preparation, any sutures inserted at the second operation must of necessity break through the barrier that has been developed. Such breach has proved a real disadvantage as recited before. Permanent silk sutures are placed in the skin but left untied. The gauze pack is then placed, particular care being taken to hold the peritoneal apron well away from the bladder wall. The three guy sutures are tied over the pack and the wound strapped with adhesive.

Figure 1 illustrates the procedure. For the sake of clarity, I have had shown only two of the temporary loop sutures and have had omitted entirely the permanent sutures in the skin.

There is very little reaction after the

exposure and rarely any need to interrupt the patient's routine save that bed confinement is required. In Figure 2 (A) the

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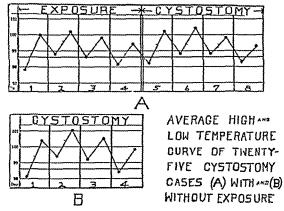


Fig. 2. Note in A that reaction after cystostomy is practically identical with that after preceding exposure. The one-stage cystostomies, B, show maximum temperature .6°F. higher than the two-stage.

average high and low temperatures of 25 patients during the four days of exposure and during the first four days of the immediately subsequent cystostomy are shown. In so far as the temperature curve tells the story, one is struck by the little difference in the reaction following the exposure and the cystostomy. The same figure (B) also records the four-day high and low temperature curve in 25 patients for whom a one-stage cystostomy was done. The maximum temperature was 0.6°F. higher for the latter.

I was really surprised to find such little difference, but, of course, there is less chance for infection in a one-stage cystostomy than in a prostatectomy or lithotomy. It was not feasible to make a similar comparison between one and two-stage prostatectomies because temperature elevation may be caused by so many other factors than wound infection. In the two series the only selection has been to use no cases running an elevated temperature at the time of operation and to exclude those with complications which might be responsible for some febrile reaction.

The exposure period has usually been four days but has varied from three to ten. Upon removal of the gauze pack the wound presents as a granulating trough. The protective inflammatory reaction is quite thin (Figs. 3 and 4). The tissues are friable and have lost some of

sure primarily for the poor risk or badly infected prostatic and for the stone cases with marked infection. I have come to



Fig. 3. Section through wall of four-day exposure wound at level of subcutaneous fat. From right to left it shows the serofibrinous exudate, leucocytic infiltration and early fibroblastic reaction.

their normal elasticity. Tissue handling must, therefore, be gentle to obtain the full benefit of the exposure. The guy sutures exactly locate the point for opening the bladder. At the completion of the second operation, whatever it may be, the temporary loop sutures previously mentioned are utilized to pull the permanent sutures into position, and the skin sutures already in place are tied. Closure is rather loose and additional support is secured by adhesive strapping.

Williams proposed the preliminary expo-

use the method in my good risk prostatics as well. The sequence here is drainage preparation by an indwelling catheter, exposure and then prostatectomy. With us, this is the two-stage prostatectomy and has entirely replaced the one-stage operation. It has been employed in about one-third of the prostatectomies (Table II). Whenever a preliminary cystostomy is desirable, the three-stage operation is done. These patients too have their early drainage by means of an indwelling catheter. The exposure technique has

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further been utilized prior to the intravesical removal of a large papillary carcinoma of the bladder and the intravesical and so consumes more of the operatingroom time of the surgeon. This objection has no weight if the procedure rebounds

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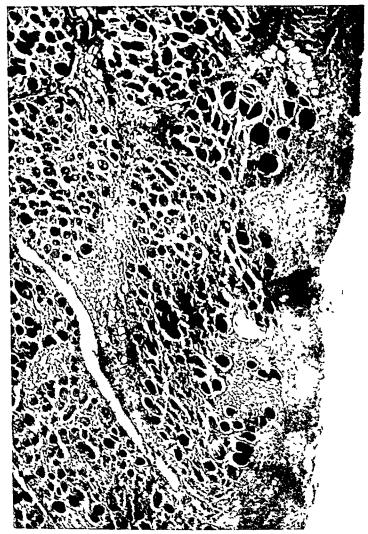


Fig 4. Reaction from same wound as Fig. 3 but at level of rectus muscle.

excision of a large diverticulum coming off from the bladder base. Entirely satisfactory access was had to both conditions. Visualization of a prostatectomy would be, in comparison, a quite simple procedure.

Certain objections have been raised to the use of the preliminary exposure. One is that additional confinement is imposed upon the patient. This is more apparent than real for, in my hands at least, the loss at the outset is more than compensated for by the gain of a materially shorter postoperative convalescence. The procedure does add another operation to the benefit of the patient. It has also been suggested that postoperative hernia may be more frequent after the exposure technique. I do not know whether this is true or not. For some years we have obtained a 70 per cent reply to our routine follow-up questionnaires but have found the answers concerning the status of wounds so unreliable that we now disregard them unless there has been the opportunity for personal inspection. I do know that 2 patients in the series of 97 have postoperative herniae, I after a three-stage and I after a two-stage prostatectomy. A

final objection is that the procedure is unnecessary since any serious infection can be prevented by simpler means. Where true, this cannot be answered. I can only say that, in my work, no other method of avoiding infection has given the same uniformity of good results.

CONCLUSIONS

- 1. Exposure of the bladder preliminary to cystostomy and other operations has invariably prevented any serious infection of or about the suprapubic wound.
- 2. The method has prime value in the poor risk and heavily infected prostatic, the prostatic with a fat abdominal wall, and all stone cases requiring lithotomy.
- 3. Open operations on the prostate and bladder can be readily done with the exposure technique and with the same relative gain in wound healing that is observed for simpler operations.
- 4. Temporary looped sutures can advantageously be placed at the time of the exposure for the purpose of later guiding permanent sutures into position. The same protective reaction is thereby gained for suture tracts as for the main wound.

DISCUSSION

DR. EDWARD L. KEYES: Let me ask three questions: First, as to the length of the abdominal incision, and whether Dr. Neff closes the rectus at all. Then, whether he does a bilateral vasotomy at the time of the first operation. Finally, I should like his views on catheter infection.

In infected stone cases preliminary exposure as outlined by Dr. Neff will aid in keeping the wound clean, and obviate the very high mortality from infection which one finds following suprapubic removal of phosphatic calculi from gravely infected bladders. But I am endeavoring to get away from prevesical section as a preliminary to prostatectomy. One can open a bladder and keep the suprapubic tissue just as clean with a tube in the bladder as though one had only opened the prevesical space. The essence of this operation is, of course, to be sure that no urine gets into the prevesical space at the time of operation.

During the time that I was doing prevesical section preliminary to prostatectomy, I en-

deavored to make it a two-stage operation, i.e., to expose the bladder in one operation and to remove the prostate a few days later at a second one. For various reasons, however, about one-third of my cases were operated upon three times; i.e., bladder exposure, cystotomy, prostatectomy. The same thing seems to hold for Dr. Ness's series. A careful study of my cases convinced me that the intermediate cystotomy was called for as a rule by prostatitis arising from catheter infection. Indeed, I found that the great advantage derived by me from prevesical section was a clearer understanding of the infectious processes in and about the prostate and in and about the prevesical space that occur during the preparation for suprapuble prostatectomy.

Inasmuch as the prevesical space can be kept clean even though the bladder is opened, I have discarded prevesical section as a preliminary to prostatectomy. I have also discarded the catheter as a therapeutic agent excepting for emergency use, and am now subjecting my prostatics to the following:

- 1. Cystostomy and bilateral vasotomy on admission.
- 2. Prostatectomy after an appropriate interval.
- 3. Decompression which can perfectly well be carried on through the suprapubic tube.

Dr. Abraham Ravich: I have had an experience similar to that mentioned by Dr. Keyes. In fact, over a year ago when Dr. Keyes first became enthusiastic about this three-stage operation, I tried it also, and since then have had about 12 such cases. In spite of bilateral vasectomy performed at the time of the prevesical section, I still continued having infections which I found extending from the vesical neck up as far as the kidneys. These infections I believe are often produced by the catheter lying in the vesical neck. The average hospital stay in these cases was prolonged to about forty-five to fifty days. Since rushing up the first stage recommended by Dr. Keyes and doing a suprapubic cystostomy and bilateral vasectomy without catheterization soon after the patient entered the hospital, I find the results are much better. Infection has been diminished and the hospital stay has been decreased to about twenty to twenty-five days. The patient starts voiding in from three to ten days, and clean wounds are the rule. I believe the three-stage operation may be of value in only the occasional case.

I am in full accord with Dr. Keyes' method as opposed to the three-stage operation as a routine measure.

DR. JULIUS J. VALENTINE: I think there is no question but that Dr. Neff's method of exposure of the bladder is indicated in many cases. I believe, however, that cystotomy by means of air distention of the bladder is much simpler. In discussing the subject, Dr. Keyes did not mention how bladder wounds may be kept clean. Perhaps he had in mind air distention, which technique he demonstrated several years ago on the service at Bellevue Hospital.

Distend the bladder with air (I use the old fashioned rubber bag with bulb for cautery outfit), select the highest point possible on the vault, incise through the muscular coats carefully until the mucosa, a bluish gray bleb, bulges into the wound. Grasp this bulging mucosa with Allis clamps, detach the air distending apparatus, press the bladder gently downward to allow the air and bladder fluid to escape through the indwelling catheter, make traction upward on the mucosa and incise it. If this procedure has been followed, no fluid will soil the wound.

I have followed this technique for over five years and have seen no infections of the wound even in cases of vesical calculus. In my experience, this technique insures at least 90 per cent primary union.

DR. DANIEL A. SINCLAIR: I was much interested in Dr. Neff's paper, and I have read Dr. Keyes' article on the same subject, but I have seen no necessity for a three-stage operation for prostatectomy or removal of calculi. I do not know why, but within the last twelve years or more I have had no severe infections of the suprapubic wound, such as one saw many years ago. We used to have much sloughing of green, gangrenous tissue. I do not know that the operation I do today is different, but I do not get the infections one occasionally saw some years ago.

Dr. Neff reported a case with 17 calculi in the bladder, citing it as a probable instance where, if the three-stage prostatectomy had not been performed, there might have been severe infection. In March, 1928, I had a similar case from which I removed about 65 large stones, each at least 1 cm. in diameter. I had to dig them out, as they formed a veritable wall cemented together with blood clots. Subsequently I removed the prostate gland,

without an unusual degree of infection ensuing. I therefore believe that though in some extraordinary cases of infection Dr. Neff's method might be tried, it should not be recommended as a routine procedure.

DR. JOHN H. NEFF, (closing): Relative to the length of the exposure incision which I make, this is determined by the operation that is to follow, being shortest for a permanent cystostomy. The average length is about 7 cm. There is no closure by suture of any part of the wound. The stay sutures in the bladder wall are of fine silk, placed with a curved intestinal needle, and do not penetrate the bladder.

I should estimate that 90 per cent or 95 per cent of our prostatics bear the indwelling catheter satisfactorily. Recently we have been ligating the vasa after the method of Colston and Alvea at the time the catheter is originally passed. Occasionally because of spasm, bleeding, infection or poor drainage, the permanent catheter has to be supplanted by a suprapubic tube. While we employ the three-stage operation rather frequently, it has rarely been made necessary by damage attributable to the presence of the catheter. By reading and conversation I have gained the impression that there is a very definite mortality attached to the routine use of an immediate cystotomy in prostatic obstruction. For the toxic prostatic, the placing of an indwelling catheter has always seemed to me the simplest and safest means of securing the necessary drainage.

I did not discuss mortality in the body of my paper because the study was solely one of wound healing. In this series the mortality was about 8 per cent. This is approximately twice our average mortality for suprapubic prostatectomy over a number of years.

I fear I may have given the impression that infection is rampant with us. I hope the incidence is no higher than in the average clinic. I am convinced that the most perfect technique in a cystostomy is no certain guarantee against a later dissecting infection. One may go into a foul bladder for stones in one stage and have the wound heal per primam. But in 25 consecutive cases of this type, a certain number are surely going to develop some nasty wounds. My experience leads me to believe that none will do so with the exposure technique, though there will be a smaller percentage healing by first intention.

INJURIES OF THE HEAD*

PAUL D. ABRAMSON, M.D.

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TEAD injuries constitute an everincreasing number of traumatic cases seen, in all probability the result of the mechanical age in which we live. On all sides we are surrounded with evidence of man's conquest of the inanimate and of his victory over the elements. all of which, their advantages notwithstanding, result in more frequent and in more serious accidents; and, of these, head traumata are foremost in importance, not only because of the frequently prolonged period required in the immediate treatment of these cases, but equally as much because of the after-effects of such injuries which frequently are more disabling and cause more economic loss than the original injury. As in many other fields of medical endeavor, there is no conformity as to diagnosis (classification) or to treatment, resulting in a somewhat confusing state of affairs, but there are certain general facts which if recognized and used as a basis of treatment will perhaps serve to place the subject of head injuries into a semiorderly category.

In the first place, there is one distinction to be made, viz., that in treating cases of head injury we are never primarily concerned with skull fracture per se, but with damage to the enclosed brain and its coverings; bony damage interests us only so much as it affects the enclosed contents. It is true that extensive fractures of the skull almost invariably damage the underlying structures, but this is not the infallible rule; and conversely, "negative" x-rays have all too often caused a false sense of security, with an underestimation of the seriousness of the intracranial pathology, and a resulting laxity and inadequacy of treatment, not infrequently resulting in sequelae which may permanently cripple the individual so afflicted.

When a head injury case is first seen, as in all cases of trauma, the first and paramount thing is to recognize shock if present, and treat it promptly. symptoms are too well known to bear repetition here, but it must be remembered that the falling blood pressure and rising pulse rate of primary shock are closely mimicked by the symptoms of medullary edema, with the exception of the rising temperature in severe medullary damage as contrasted with the subnormal temperature of shock. Until shock is combated, nothing can be done, assuming an attitude of "masterful inactivity" even in the face of family discontent; for we can rest well assured that if the patient fails to react from this state any measures which we may have undertaken would but hasten the end.

There is a peculiar thing about the treatment of shock in head trauma: most of the usual methods for combating it under ordinary circumstances are frequently contraindicated. Thus, in shock the lowered head is of great value, while in head trauma the elevated head is desirable. As a result, unless an alarming degree of shock be present, the flat position is to be used. Again, whereas fluids are useful in the treatment of this condition, too much fluid is harmful in intracranial damage; so again, unless an unusual degree of shock be existent, it is perhaps best not to force fluids. Morphine is the drug par excellence in the treatment of shock, but Carl Rand lists at least three contraindications to its routine use in this type of case, viz., (1) in a case of head injury, especially of severe grade, the increased intracranial pressure usually causes embarrassment and depression of respiration and pulse; morphine accentuates this depressing action and it often fails to quiet; (2) mor-

^{*} Read in part before North Louisiana Sanitarium Staff, November, 1930.

phine contracts the pupils and thus masks the development of localizing signs; and (3) it tends to mask the symptoms of

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Fig. 1. F. G., aged three years, admitted to Charity Hospital October 15, 1930. Despite quite definite fracture, the patient presented absolutely no clinical evidence of intracranial pathology. Such an occurrence is more frequently seen in children than in adults.

oncoming stupor due to cerebral edema or hemorrhage. As a result, the treatment of shock in head injuries largely resolves itself into absolute quiet in bed in the flat position, external heat and the use of luminal. chloral or some similar sedative.

After the patient has reacted from any shock that may have been present, a more careful survey must be made with a view of determining the degree of intracranial damage present. Emphasis is again placed on the fact that it is this intracranial damage that is the paramount issue and not the bony damage itself. True it is that the degree of skull injury is a fair index of the amount of intracranial pathology to expect, though there is by no means an absolute correlation; especially in children is it true that notwithstanding severe bony damage there may be relatively little brain damage (see Fig. 1). The site of scalp laceration or contusion frequently indicates the site of severest brain injury, but the possibility of the contrecoup mechanism must be borne in mind both

as regards intracranial damage and skull fracture; the entire brain is frequently damaged, or in the words of Frazier:

One should see in the severely contused and lacerated brain a diffuse lesion, areas of extravasations, minute petechial hemorrhages far distant from the site of impact, in hemispheres, pons or medulla, minute or gross lesions. Superimposed on these there is a rapidly spreading edema from cortex to brain stem . . . thus one should visualize the tissues of the damaged brain.

The usual classification of brain damage is one based on an admixture of disturbed physiology and disturbed anatomy. Most grade the cerebral damage into (1) concussion, (2) contusion and (3) laceration, there being only a difference of degree between them and no sharp dividing line; with each there is a variable degree of cerebral edema. In concussion, and there is no unanimity of opinion that such a condition really exists, the prime clinical feature is a temporary period of unconsciousness, the severity of the injury presumably interrupting the physiological integrity of the brain cells. It is unaccompanied by actual brain damage, and hence a bloodless spinal fluid is obtained. Laceration and contusion, on the other hand, cause actual brain damage and can occur entirely independently of any actual fracture, in such cases resulting from the jolting of the brain inside its bony encapsulation.

These three grades of cerebral damage are, in themselves, primarily of little importance excepting as they result in severe edema or intracranial hemorrhage which in turn produces that all-important result of head injuries: increased intracranial pressure. It is this increased pressure which results in (4) medullary compression and (5) medullary edema; and it is this disturbance of the medulla wherein are located the so-called "vital centers" that is responsible for the extreme seriousness of head injuries.

Thus we see that intracranial damage may be classified under 5 groupings: (1) cerebral concussion, (2) cerebral contusion, (3) cerebral laceration (4) medullary compression and (5) medullary edema. Let it be understood, however, that clinically cases cannot be neatly pigeon-holed into any one classification but frequently present a composite picture of 2 or more grades of intracranial pathology.

Fractures of the skull permit of a simpler classification and must be considered because of their relationship to cerebral damage. According to location they are either (1) basal or (2) vault fractures; and in turn, the fractures of the vault may be subdivided, depending upon the number and position of the fragments, into (a) fissured, (b) comminuted (c) diastatic (separated fragments), (d) depressed or (e) perforated. Obviously, the depressed type of fracture is more likely to severely damage the brain. As Reed points out, for practical purposes, fracture of the skull may be dismissed unless it falls into one of 3 types: (1) depressed fracture of the vault, (2) a compound fracture under a scalp wound and (3) fracture of the base when the fracture line extends through the external auditory meatus or through one of the accessory bony sinuses. The possibility of a contrecoup fracture must not be overlooked.

When a patient who has sustained a head injury is first seen, whether he has reacted from his shock or not, there is no reason at all for madly rushing him to the x-ray room to see if he has a "fractured skull or not." Such information is of little real value, is often misleading and frequently the handling of the patient necessitated by taking the picture is harmful; and as has been previously observed, "negative" x-ray findings often give an unwarranted optimism and may result in laxity of treatment. All the information required, certainly all that is necessary at the initiation of treatment can be determined by clinical examination. X-rays should be taken, of course, as much for a matter of record as anything else, but this should not be allowed to supersede everything else that is done for the patient. That is, the patient's

treatment must not depend upon the presence or absence of a demonstrable fracture, but upon his clinical condition.



Fig. 2. E. B. R., aged twenty-two years, admitted to North Louisiana Sanitarium November 15, 1930. Although other views of the skull showed no more evidence of fracture than the lateral, this patient was unconscious for five days and showed signs and symptoms of marked intracranial pathology for over a month before returning to normaley under medical (conservative) therapeusis. Although it is true that it is often difficult to satisfactorily demonstrate basal fractures with the x-ray, this patient had no clinical evidence of basal fracture, the brain injury apparently being in the left frontal lobe. As this case well illustrates, severe intracranial damage frequently occurs without any actual skull fracture.

Clinical evidence of fracture is always to be looked for first, with the object uppermost of correlating it with possible intracranial pathology. If a laceration of the scalp is present, it is a simple matter to daub the wound and surrounding area with a little iodine and insert the gloved finger into the wound, endeavoring to feel any bony defect or other evidence of fracture. Such an examination is by no means conclusive, but certainly helpful. On digital examination, evidence of depression must be carefully sought for, and it is in a case of probable depression that x-rays are of great value. Serious fractures of the vault can usually be palpated; serious fractures of the base usually, though not invariably, evidence themselves by periorbital or perimastoid bleeding, conjunctival hemorrhage or escaping blood or spinal fluid from the nose, mouth or ears. Naturally, severe cranial damage usually indicates severe intracranial damage but this is not invariable, and it is to be remembered that severe brain damage can occur with an intact skull (see Fig. 2).

As Frazier has aptly said, cerebral trauma is as much a neurosurgical problem as cerebral tumor. Advantage must be taken of localizing signs as evidence of cranial or intracranial pathology. The eyes are most frequently observed for evidence of severe pathology. Blakeslee, in a series of 610 cases at the Harlem Hospital, found that 78 per cent of cases of fracture showed eye signs: 70 per cent of these signs were some kind of pupillary alteration. Immediately after the injury the pupils are more or less dilated and sluggish in reaction; as the stage of shock passes off the pupil returns to normalcy unless there is a marked increase of intracranial tension when dilatation and sluggishness may remain. Pinpoint pupils are seen in the early stages of supra-cortical hemorrhage; a dilated and fixed pupil is usually seen on the side of the lesion and like nystagmus, is an unfavorable sign. Fundal changes are of little value early as an index of intracranial pressure, though some dilatation and engorgement of the retinal veins are seen early in cases of increased tension. According to Armour, about 12 per cent of cases show some cranial nerve involvement; in order of frequency the nerves involved are the seventh, sixth, eighth, third and second. Greenleaf has claimed that unilateral elevation of the temperature in the axilla occurs on the side opposite the lesion.

Concussion, the mildest form of intracranial pathology, is evidenced by a primary brief period of unconsciousness, mental confusion or disorientation, lack of localizing cortical signs and bloodless spinal fluid. However, Mestrezat, Bouttier and Lorge have, according to Armour, described a spinal fluid "concussion formula" which is detectable in 80 per cent of the cases of concussion without head wounds: the spinal fluid findings consisting of increased tension, increased albumin, normal chlorides, slightly increased sugar, absent fibrin and normal permeability. If the treatment of this condition is not discontinued too early, it usually leaves the patient unscathed.

Cerebral contusion and laceration are severer grades of the same process. Whether due to a concomitant cerebral edema or to concussion, such injuries are frequently associated with varying degrees of mental alteration varying from simple transient disorientation to wild mania or deep coma. If a spinal tap be done, almost invariably a bloody spinal fluid under increased tension is found. It is this increased intracranial pressure that so frequently accompanies the severer degrees of cerebral damage that is responsible, through pressure on the medulla, for the production of some of the classical signs of head injuries. In increasing medullary compression there is seen the compensatory slowing of the pulse (which in reality is the most reliable clinical sign of increasing intracranial pressure). Vomiting is entirely undependable as an index of increasing pressure: it is much more often due to nervousness or excitement than to any increased intracranial pressure and is rarely projectile. Likewise, blood pressure readings are entirely worthless as a reliable index of increasing intracranial tension; occasionally a compensatory rise of blood pressure is seen accompanying increased pressure, but this factor is so variable that reliance upon it will be frequently misleading. As medullary compression passes into medullary edema the patient lapses into extremis: falling blood pressure, rapidly increasing intracranial pressure, rising pulse rate and hyperpyrexia are all ominous signs of impending disaster.

Aside from certain definite surgical indications, the thing of most importance is, after all, the amount of intracranial pressure.* So much so that Rodman and Neu-

^{*}Those who practice extreme conservatism argue that actual brain damage, and not increased intra-

bauer have discarded the usual methods of classification and grouped all cases of head injuries into 3 types, depending upon the degree of intracranial tension. Increasing intracranial pressure is usually evidenced by deepening coma (the pressure causes an acute anemia of the brain cells and loss of function), slowing pulse, slow deep breathing and increasing spinal manometric readings. If compensation breaks, the picture of medulle arydema replaces that of medullary compression.

The surgical indications in head injuries are definite and relatively few; aside from the repair of scalp wounds there are just 3 indications for surgery (Reed):

- (1) To prevent infection, as after a compound fracture involving the scalp or accessory sinuses.
 - (2) To reduce cerebral compression, or
- (3) To elevate depressed fractures of the vault.

That is, if there is no depressed fracture of the vault, if there is not an alarming degree of cerebral compression present, and if there is no danger of infection from a compound fracture, conservative (medical) therapeusis is ndicated in handling the particular case of head injury in question.

Treatment of head injuries varies greatly; in the words of Dandy, "The treatment . . . so largely in vogue at present, when taken compositely, is a curious admixture of tradition, scientific facts and of fallacies which pass under the cloak of science." Measures recommended vary from one extreme to the other. No less an authority than Dandy states that 70 per cent of head injury cases will recover if left absolutely alone, 20 per cent will die regardless of what is done, and a scant 10 per cent are benefitted by judicious treatment, and concludes that these pa-

cranial pressure, is the cause of the clinical symptoms. It certainly is difficult to otherwise explain those cases which are sometimes seen in which there is profound coma, etc., but in which, with no apparent blockage (Queckenstedt) there is normal, or only slightly elevated spinal manometric readings. A review of our records fails to reveal a single instance of the spinal hypotension of Leriche, though it is said to occur in about 3 per cent of head injuries.

tients should be left absolutely alone until it is evident that nature is unable to cope with the situation.

Most, however, do not adopt such a "radical conservatism"; there are certain, though few, things that are frequently used. In those cases in which no surgical indication is present, the patient is put to bed in Fowler's position, thus mechanically alleviating the increased intracranial pressure; an ice-bag is usually placed to the head: this is probably one of the "traditions" to which Dandy had reference—in the conscious patient it no doubt serves to keep him still for fear it will topple off, but otherwise its value is extremely doubtful, though almost universally used. Saturated MgSO₄ by mouth, if the patient is conscious; by duodenal tube, if the patient is comatose (or by rectum as the English do) as is well known, serves indirectly to reduce intracranial pressure. Intravenous hypertonic solutions of various kinds are of undoubted value; of these, 50 per cent glucose in 50 to 75 c.c. amounts is definitely the best of the lot. Hypertonic saline, which has at times been used, in addition to having no nutritional value has several distinct disadvantages including the toxicity of the Na ion and the fact that the NaCl diffuses into the tissues and there attracts water, thus waterlogging those structures primarily dehydrated. In the use of glucose, it is quite important that urinalyses be done before treatment is instituted and while it is being carried out; diabetics are not immune to head injuries.

The rôle of spinal puncture in relieving increased intracranial pressure is another one of the measures about which there is no agreement, varying from absolute abstinence (Dandy, who believes that spinal puncture but serves to re-traumatize the intracranial structures) to total drainage (Temple Fay). No doubt a middle course is wiser and certainly it is more universely adopted. Probably drainage in the first twelve to twenty-four hours is inadvisable as it only disturbs an already

too-disturbed patient; it may defeat a compensatory pressure having for its purpose the compression of bleeding vessels. And if, within this short preliminary period, the pressure reaches dangerous levels, the case is probably too far gone to save, regardless.

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Probably a safe rule in performing spinal drainage is to draw off sufficient fluid to reduce the pressure one-half of the increase above normal. It is extremely important, in performing spinal taps, that the actual pressure be recorded; absolutely no reliance can be placed upon the number and force of the drops from the needle, because of the great variation in needle bore, the possibility of tissue impinging against the needle, of the needle being slightly bent, etc. All these factors obviate the possibility of accurate spinal pressure estimations by the escaping fluid. If a regular mercury or water spinal manometer is not available, a very passable substitute can be had in the form of the ordinary blood pressure manometer providing that the cuff is detachable: the rubber connection that is found in all sets of antimeningococcic serum for intraspinous use forms an admirable connecting link between the spinal needle and the mercury column. Furthermore, in reducing the pressure, no reliance should be placed on the removal of any certain quantity of fluid; it is the reduction of pressure that is essential and readings should be taken before and after drainage. À propos of intracranial pressure measurements, it is interesting to note that Bailliart has described an instrument called the "ophthalmodynamometer" by which the intracranial pressure can be determined by pressure on the eyeball and simultaneous observations of the central artery of the retina. This method has not found very widespread use.

Sedatives such as luminal are preferable to bromides because of the cumulative effect of the latter. Restriction of fluids to practically nothing at first is of great value; this is all too frequently overlooked in the handling of head injuries. Restriction of fluids, according to Temple Fay, should be continued over a relatively long period of time.

If the increasing intracranial pressure fails to respond to these measures of position, epsom salts, intravenous glucose and spinal drainage, the case falls into one of the indications for surgical intervention: cerebral compression. Cerebral compression may be the result of (1) cerebral edema of severe degree, (2) cerebral laceration and severe subdural hemorrhage or (3) extradural hemorrhage. Characteristically, extradural hemorrhage evidences itself by a primary coma, a period of lucidity and then secondary unconsciousness, and if such a chain of symptoms presents itself, there is immediate need for subtemporal decompression, to control the bleeding as well as to relieve the compression. The bleeding almost invariably is due to a tear in the middle meningeal artery which enters the skull through the foramen spinosum, or to a tear in one of its branches. If, however, no such characteristic symptom-chain is present, it may be impossible to differentiate clinically extradural hemorrhage, subdural hemorrhage or cerebral edema of severe grade. Nevertheless, the indications are clear for a subtemporal decompression, dealing with whichever condition presents itself. However, a preceding spinal tap may serve for a differentiation as a clear fluid mitigates against the diagnosis of subdural hemorrhage, narrowing the probable diagnosis down to extradural hemorrhage or cerebral edema: if there has been, in addition, a period of lucidity and then secondary coma, the diagnosis of extradural hemorrhage will be practically certain. Spinal drainage will never relieve a case of extradural hemorrhage and may be actually harmful (one of the dangers of indiscriminate spinal puncture as a routine procedure); but it may at times obviate the necessity of operation in cases of subdural hemorrhage, unless a severe degree of intracranial pressure be present.

In relieving cerebral compression, regardless of the cause or location of the

cerebral laceration, and regardless of the exact pathology involved, a subtemporal decompression is the procedure par excellence. Armour points out the following advantages of this procedure: (1) the squamous portion of the temporal bone is the thinnest part of the vault of the skull and so it is easiest of removal; (2) its removal exposes the middle meningeal artery which is most frequently damaged: (3) the part of the brain exposed is the temperosphenoidal lobe, a silent area of the brain and (4) it allows drainage of the middle fossa in its lowest point. It must be remembered that in relieving intracranial pressure it is essential to open the dura; simply removing a bony plate is useless. Incidentally, Lambert Rogers of Cardiff has recently described a very ingenious "skull plow" which promises to greatly simplify the technique of osteoplastic craniotomy.

The second definite operative indication is to relieve a depressed fracture of the vault. Here the incision is made so that the involved bone is exposed; the depressed bones are elevated and left in place to serve as a graft if the wound is not compounded and there is no danger of infection. Failure to properly elevate depressed fractures may result in persistent headaches, personality changes, Jacksonian epilepsy, localized paralysis, brain cysts, etc.

The third operative indication is for the prevention of infection. The management under this indication depends on whether the fracture is of the vault, into the frontal fossa or into the base. If in the base, and there is bleeding from the ear, the ear should be plugged with sterile cotton soaked in some antiseptic solution and no attempt made to aspirate or "blow out" the ear; in examining the ear to see if the bleeding is really coming from a rent in the ear drum, aseptic precautions should be used.

If the compound fracture is of the vault, the involved area is widely shaved and prepared and all loose fragments of bone are removed, because of the potential infection. The dura is inspected for lacerations and, if present, the underlying brain probed (preferably with an old soft rubber catheter of small size) for penetrating fragments which must be removed. The dura is closed, if necessary with a fascial graft, to prevent infection or hernia (fungus) cerebri. Likewise, the scalp should be closed without drainage. If a large bony defect exists it can be repaired at some future date.

If, however, the fracture extends into the frontal fossa or accessory nasal sinuses, the possibility of infection is greatly enhanced. Meningitis is the chief hazard of such a fracture. If the fracture is of the posterior wall of the frontal sinus an osteocutaneous flap is made, exposing the interior of the front al sinus. Treatment thereafter is carried out as in compound fracture of the vault. If, however, the site of fracture cannot be thus attacked. Teachenor has recommended drainage of the frontal sinus because these patients have an intranasal irritation due to blood. etc., which causes an irresistible desire to sneeze; if the frontal sinus is closed tightly, obviously such sneezing will but serve to force infected material into the brain and meninges, whereas if a drain is in place, the tension will be less and the infectious material will escape through this opening.

Briefly, then, if no one of the 3 surgical indications is present, viz., (1) compound fracture with danger of infection, (2) depressed fracture of vault or (3) marked compression (hemorrhage edema) the patient is put to bed with elevated head, ice-bag to head (sic!), MgSO₄ by mouth or tube, 50 per cent glucose by vein, and after the first twelve to twenty-four hours, unless definitely contraindicated, spinal drainage is instituted. Fluid intake is limited. Even though the patient responds nicely to this therapy it must not be abandoned too soon because it is by such inadequate and curtailed therapy that some of the more serious sequelae such as persistent headache, vertigo, personality changes, etc., result.

All head cases must be considered serious until proved otherwise, and they should, no matter how apparently trivial, be kept in bed at least a week to avoid, if possible, such unfortunate and handicapping sequelae.

Frequently, following the severer grades of head injuries, mental changes persist over a relatively long period of time: these alterations are extremely varied and protean in their manifestations. As a rule, these are rather indiscriminately grouped under the rather ambiguous appellation of "traumatic psychosis." After a varying length of time, weeks or even months later, these mental aberrations disappear, though at times, even in the absence of a fracture, permanent mental changes occur.

The sequelae of head injuries must not be forgotten. One of the most frequent and troublesome of these is persistent headache and vertigo: it is in these cases that Penfield has recommended the spinal insufflation of air, on the theory that these symptoms are the result of thin filamentous adhesions which are broken up by the entrance of the air.

A more serious sequela is that of chronic subdural hematoma (pachymeningitis hemorrhagica interna) which following even trivial trauma may evidence itself in several weeks or months either as a disturbed mentality (and is frequently misdiagnosed "traumatic psychosis") or as a symptom-complex of persistent increased intracranial pressure. The recognition of this condition is important because the spontaneous absorption of the encapsulated clot in the avascular subdural space is rare, while operative removal is followed by a brilliant cure.

An intracranial aerocele or pneumatocele is occasionally seen following communication between sinuses or mastoid and the intracranium. It evidences itself by increased intracranial pressure and sometimes sneezing followed by cerebrospinal rhinorrhea. X-rays readily confirm the diagnosis. The treatment is repair of the dural defect.

Subdural hydroma is sometimes seen and resembles a subdural hematoma except that the accumulated fluid is more serous in character and the encapsulation is usually thinner than that surrounding a hematoma. The symptoms are manifested as a persistent headache and a syndrome of increased intracranial pressure, and may be alleviated by removal of the accumulated fluid.

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Persistent involvement of the cranial nerves, particularly the facial, at times gives great concern. There are several other sequelae which are seen rarely, but their rarity does not warrant mention here.

Concerning these results, or after-effects of head injuries, one must not be too hasty in attributing symptoms or signs to a previous trauma about the head. This point is well illustrated by a case recently seen.

J. N., a colored male aged forty years was admitted to the Sanitarium complaining of persistent headaches and some mental disturbances. He dated his symptoms quite definitely to a head injury received some two months previously. There was, of course, the all-important medico-legal aspect of the case. Physical examination revealed little of note except fixed and unequal pupils, which, incidentally, has been claimed by some to occur as the result of head injuries, in certain cases. Spinal fluid examination revealed a 4 plus Wassermann reaction and a paretic curve. Needless to say, the symptoms have markedly improved under anti-luetic treatment.*

SUMMARY AND CONCLUSIONS

- 1. In treating head injury cases it must be fully realized that it is the intracranial damage with which we are primarily concerned and not the presence or absence of a fracture.
- 2. There is no need for rushing the patient to the x-ray room to demonstrate the presence or absence of a fracture: the
- * It must be remembered that some claim that trauma, by producing a situs minoris resistentiae, may actually precipitate paresis in a luetic individual. See the recent excellent discussion of this subject by Klauder and Solomon, J.A.M.A., 96: 1-7, 1931.

clinical condition of the patient is the essential thing.

3. Treatment of shock must, of course,

preclude all other therapy.

- 4. There are 3 surgical indications in the treatment of head trauma: (1) to prevent infection, (2) to elevate depressed fractures and (3) to relieve high grades of cerebral compression, whatever the cause.
- 5. If no surgical indication is present the case is best treated with elevated head, limited fluid intake, MgSO₄ by mouth, hypertonic glucose by vein and, after twelve to twenty-four hours, unless definitely contraindicated, spinal drainage.
- 6. Absence of demonstrable fracture must not permit of laxity or insufficiency of treatment, as it is entirely possible to have severe grades of intracranial damage, even a fatal outcome, with no actual fracture.
- 7. All head injury cases must be considered serious until proved otherwise; adequate treatment will frequently prevent the development of serious and handicapping sequelae.
- 8. The possibility of the development of late sequelae must be remembered in all head injury cases, but symptoms must not be attributed to a previous trauma without proper study.

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*Continued from p. 36.

ARGENTAFFINE TUMORS OF THE SMALL BOWEL

WITH REPORT OF TWO WHICH CAUSED INTESTINAL OBSTRUCTION*

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ROM the first report of Merling¹ in 1835, at which time he reported a case of primary carcinoma of the appendix, to 1908, McWilliams2 was able to collect from the literature go cases of primary appendiceal carcinoma. Meyer³ in 1915 compiled 269 cases, and Jackson⁴ adding 54 in 1923 brought the total to 317. In the intervening seven years between this publication and the present, investigators have submitted many papers reporting additional tumors. The collection has become so large that their single occurrence is hardly noteworthy. Many of these studies are entirely adequate in review, and because of this previous literature the appendiceal tumors are not considered here.

Carcinoid or argentaffine tumors occurring elsewhere in the bowel other than the appendix are less common. One can only guess at the number of early tumors of the small bowel which were of carcinoid character because of the relatively recent separation of them from the great group of intestinal cancer, but from previous collections of cases it is evident that they have been rare. For instance Nothnagel⁵ in an analysis of the material from the Allegemeines Krankenhaus in Vienna from 1870 to 1893 found 343 intestinal carcinomata from 41,838 autopsies. Of these but 10 were of the jejunum, ileum or appendix, which are the principal sites in which argentaffine tumors have been reported. Similarly Leichtenstern⁶ found 780 intestinal carcinomata with only 28 from the ileum, jejunum and appendix. Lubarsch? in 1888 could find only 35 cases of tumor of the small intestine reported in the literature. G. Heimann's reports of 20,054 cases of cancer in the Hospital of Prussia; 20 were in the small bowel. Stengel,

combining the statistics of Madyl, Nothnagel, Zeiman, Muller and Bryant, shows that 13.4 per cent of all carcinomata to occur in the cecum, appendix and small bowel with the cecum producing over 50 per cent of these. Brill¹⁰ concludes that 2 to 3 per cent of all cancers of the gastrointestinal tract occur in the small intestine. In view of these figures and realizing that not over one-half of this total are tumors of the carcinoid type, the rare instance of argentassine tumors here is impressive.

The probable reasons for the low occurrence of malignancies in the small bowel as Bunting,11 Waldeyer,12 Birch-Hirschfeld,13 and Ransom,14 have indicated are: (1) the lack of epithelial transition points; (2) the absence of areas of irritation; and (3) the poor nutritive qualities of the bowel wall. The reason for the occurrence of argentaffine tumors occurring here are just as unsatisfactory, and no less than a dozen theories have been advanced in explanation of their development. It is a needless repetition to include them here as Forbus¹⁵ has followed these theoretical developments chronologically from Berger's16 report in 1882 to Masson's17 recent and apparently conclusive work. We wish to add to Forbus' list Ehrlich's18 theory, published in 1914, that the tumors arose from Auerbach's plexus. He believed that they were immature neurocytomata, a theory with which Masson does not agree. In 1928 Semstroth 19 reported a case of a patient dying from other causes showing at autopsy a small, firm, white and apparently homogenous nodule on the top of the head of the pancreas. It appeared much like an islet. There were several nodules in the duodenal wall somewhat smaller than these but of a similar character both in gross appearance and cell morphology.

They looked like carcinoids although they showed no reducing granules when stained by Hasegawa's²⁰ method. In the muscularis of the duodenum were several adenomyomata. All of the tumors were in the first two portions. He concluded that the tumors arose from faulty differentiation of the entoderm, heterotopic in the duodenum, and homotopic in the pancreas, a view that recalls Trappe's²¹ theory. The name "hamartoma" (E. Albrecht) was applied to them.

The present theory of Masson's 17 seems, at most, possible. He concludes that the cell of genesis lies at the bottom of the glands of Leiberkühn.22 They were described by Nicolas Kultschitzky²³ in 1897 and occur in the gastrointestinal tract from the stomach to the rectum. According to Masson, a cell, by budding and emigration, grows into a nerve where it assumes its type. The cells do not normally propagate, but pile up in the nerve because of the obstructions of ganglia. They may occasionally break out however into the adjacent tissue. The neurocrine cells proliferating in this abnormal medium form a nidus which in development assumes the characteristics of argentassine tumor.

Non-invasion and the non-metastatic characteristic of the carcinoids were the bases of early differentiation of carcinoids from carcinomata. Recent studies have shown them to be not all benign. Ransom11 in 1890 described a carcinoid of the ileum with metastases in the liver and though many doubted the carcinoid character of this tumor there now seems little question as to the true nature of it in the case of one patient. This patient died from the tumor growth. It is interesting to note that Ransom held the vacuoles in the tumors to be blood vessels rather than degenerating spots which was then the common belief. Masson, after thirty-eight years, proves the vacuoles to be the vascular centers of cellular rosettes.

Walter²¹ in 1896 described a carcinoid invading the gut wall and mesentery for a short distance. Stewart and Taylor²⁵

reported a case of carcinoid tumor of the appendix which showed large pelvic deposits of the same sort of tissue. These



Fig. 1. Tumor on posterior lip of ileocecal valve.

masses were retrouterine and 4 to 5 cm. each in size. The appendiceal tumor was invading the peritoneum. All of the tumor was removed eleven years ago and the patient is living and well. They collected from the literature 17 other cases of carcinoid tumor with evidence of metastasis. Of 8 primary in the appendix and o primary in the small intestine, they found that 12 had metastasized to the peritoneum, 6 to the regional lymph glands, 7 to the liver, and 1 to the pleura. It appears from this as well as from our own experience that the extending tendency is much stronger in the tumors of the intestine than in those of the appendix.

Dukes and Lockhart-Mummery²⁶ report a seventy-six-year old woman who had general indigestion for a year, and in whom a tumor on the posterior lip of the ileocecal valve which constricted the lumen of the ileum and projected into the cecum was found. The lymph glands behind the cecum were very large and infiltrated. The tumor gave the argentaffine reaction of Masson. Ransom,¹⁴ Warren,²⁷ Brocher,²⁸ McGannan and McCleary,²⁹ and Thibadau and Burke,³⁰ report tumors at or near the ileocecal valve with partial obstruction, intussusception, or prolapse of the ileum and regional extension to the glands or peritoneum.

Two cases are recorded here which presented symptoms of chronic intestinal obstruction due to this rare tumor. One

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Fig. 2. Typical stroma, cell islands and rosettes.

was in the ileum and had invaded the adjacent lymph nodes, and the other arose from the last 2 in. of the ileum, proving of interest because of its unusual situation and structure.

CASE REPORT

CASE I. Mr. W. P. Male, white, aged sixty-one. Service of Dr. W. I. Terry.

Twenty years before entry this patient had had an appendectomy by an unknown surgeon. Ten years before entry external hemorrhoids had been removed for their local symptoms. The patient had lived otherwise normally except for recurring attacks of headache of migraine type coincident with indigestion and diarrhea. The attacks were at from one to three week intervals and would last two or three days, ending spontaneously. For six months before entry the attacks were intensified, the diarrhea was profuse with small amounts of fresh blood and severe lower abdominal pain before and after stools. There was no loss of strength of weight.

At physical examination the heart and lungs were found to be normal. The abdomen had a well healed, right lower quadrant scar below which was a hard palpable mass 3 cm. in diameter. The cecum was tender and boggy. The liver projected 2 cm. below the costal margin. The abdomen was otherwise negative. Proctoscopy showed a mild injection of the rectal mucosa. The prostate was normal.

An x-ray series showed a normal gastrointestinal tract excepting a constant defect in the cecum near the ileocecal valve which was apparently due to a tumor in the cecum. At operation a mass of omental adhesions was



Fig. 3. Tumor occupying entire bowel wall.

found in the region of the old wound. In this plastic mass was a small gauze sponge surrounded by fibrous tissue. Within the cecum was a pedunculated tumor projecting from the posterior lip of the ileocecal valve (Fig. 1). Arising by a root stalk of fibrous tissue 1 cm. long and I cm. in diameter, it expanded abruptly into a spherical mass 4 cm. in diameter. The mucosa rose up the stalk to the periphery, and the upper surface was bare. Upon section the fibrous strands radiating from the head of the pedicle were found to support a very yellow, friable, cellular tissue which in areas suggested an adenomatous pattern. There were no extensions or metastases. The tumor (Fig. 2) upon microscopic studies showed a heavy fibrous stroma, lightly infiltrated with lymphocytes and supporting sheets and islands of medium sized cells with pale granular nuclei and moderately palestaining cytoplasm. Some areas suggested an adenomatous arrangement and others showed a peculiar but characteristic formation of rosettes with vascular centers. Mitotic figures were rare. The cells gave the silver reaction of Masson.

Case 11. Mrs. S., female, white, aged fifty-one. Service of Dr. J. H. Woolsey.

The patient was in good health until four years before entry when she began to have a moderate distention, relieved by belching. Over the ensuing two years this symptom gradually increased and she would become extremely distended, then gain relief after a day or two of diarrhea. The attacks, occurring at first about once a month increased in number until in the nine months prior to entry



Fig. 4. Mesenteric lymph glands replaced with tumor cells.

they were occurring every two days. She began to vomit bile-stained mucus and food particles one to two hours after meals, had a persistent light brown diarrhea and a heavy midline abdominal pain which would be relieved by the passing of feces or gas. She lost 52 lb. in the last nine months of illness.

Physical examination showed a normal heart and lungs. There was visible peristalsis over the whole center of the abdomen with movements in both directions. The abdomen was spastic with moderate epigastric tenderness. A gastrointestinal x-ray examination showed barium in the lower ileum at twenty-four and forty-eight hours with dilatation of this part of the bowel. A small bowel distention displaced the colon.

A laparotomy was done for intestinal obstruction, and a constriction was found in the terminal ilcum 26 cm. from the ileocecal valve. The bowel was widely dilated above and collapsed below this point. Thirty-five centimeters of the bowel were resected followed by lateral anastomosis. The patient recovered rapidly and has remained well for one year since operation.

The gross specimen (Fig. 3) showed the bowel wall infiltrated with tumor cells in a linear manner over a plaque 4 cm. long and running from the mesentery around the bowel for $1\frac{1}{2}$ cm., thus forming a tumor plaque of roughly oval shape, $\frac{1}{2} \times 1\frac{1}{2} \times 4$ cm. in size. The tumor occupied the entire bowel wall with thick cell islands in the submucous and sub-

serous areas from which cords of similar cells extended through the muscularis. The mucosa was not eroded and the serous surface

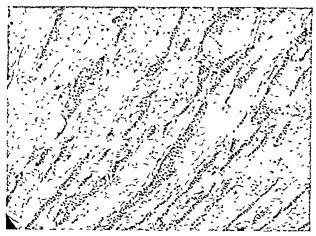


Fig. 5. Typical cells in unusually heavy stroma.

was smooth. This plaque was folded directly inward through 180° forming a shelf, projecting into the lumen of the bowel causing a partial obstruction. In the mesentery 1 cm. from its attachment were 4 glands from 14 to 1 cm. in diameter which were replaced by tumor cells (Fig. 4).

Microscopically (Fig. 5) the tumor was composed of sheets and cords of small to medium sized cells with pale, vesicular nuclei and scant pink cytoplasm, held in a smooth muscle and fibrous stroma. They gave the silver reaction of Masson.

SUMMARY

A review of the literature shows that carcinoids of the appendix are comparatively common conditions. They occasionally invade the mesentery or even lymph nodes but have not been known to cause death. On the other hand, similar tumors of the small intestine are less common and have a higher metastatic activity. They have been known to invade the liver as well as adjacent lymph nodes. Two cases are reported in which carcinoids caused obstruction of the ileum requiring operation. Invasion of contiguous tissues and metastasis to lymph nodes occurred in one. Even after such metastasis the prognosis is good, as there is no record of postoperative recurrence.

[For References see p. 95.]

TRUCKERS' ANKLE SPRAIN*

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CHARACTERISTIC sprain of the ankle and foot has often been observed by the writer among stevedores and warehouse laborers employed as truck hands. Because of the mechanism of this injury and its frequency in these workers, I have designated it "the truckers' ankle sprain." This condition arises when the foot is accidentally caught and wedged in between the platform of a four wheel hand truck and the floor and is virtually an incomplete or transient backward displacement of the foot on the leg at the ankle joint. The symptoms in some of these cases are mild and of short duration, the patient continuing at work, while in others, they are decidedly disabling in character due to the injury to the ligaments of the ankle, subastragalar joint and the adjacent tendons.

Mechanism: The ordinary four wheeled hand truck is the vehicle most employed in industrial plants to convey raw or finished products from one department to another. The capacity of this truck when fully loaded, in the plant I am making special reference to, is about 2000 lb. Two men, one at the rear pushing and the other at the front pulling, are necessary to operate this truck. If, for some reason or other, one lags and the truck gains momentum, the foot of the man who is pulling, is caught and becomes wedged in between the platform of the truck and the floor. The foot is usually in a position of plantar flexion (the heel raised and the body weight on the toes) or it may be flat upon the floor. In either event, the violence is from behind exerted upon the back of the lower leg which tends to force the foot backward and the leg forward. In the attempt to extricate it from this position, the foot will be forced sidewise and the

lateral ligaments, either the internal or external, will be sprained.

The structures involved in the injury are the tendo Achilles, the tendons of the tibialis posticus and peroneus longus, the capsular and lateral ligaments of the ankle joint and the interosseous ligament between the astragalus and the os calcis. A sprain of the capsular ligaments occurs at all of its attachments to the margins of the lower borders of the tibia and the margins of attachment to the astragalus and os calcis.

The ankle mortise, consisting of the articular surfaces of the tibia and fibula, is pushed forward and it may or may not carry with it the superior articular surfaces of the astragalus. The head of the astragalus is forced downward and inward upon the scaphoid, carrying the latter with it. The strong inferior calcaneoscaphoid ligament, the long and short plantar ligaments, are strained and the foot as a whole is elongated. The midtarsals and metatarsals receive the impact and are jammed against each other. The force then is finally dissipated in the metatarsal heads and toes. Occasionally, a Stave fracture of the base of the first metatarsal may occur.

Symptoms: In the milder varieties of this sprain, when the patient can disentangle himself from the truck quickly, the symptoms are confined to the heel tendon and the lateral ligaments of the joint. These patients may continue at work for an hour or two when they develop pain and stiffness in the ankle, some swelling and tenderness along the margins of the joint and the back of the heel.

In the more severe variety, the disability is immediate, the pain in the heel, ankle and foot is intense, and the patient is unable to bear any weight. The examination shortly after the accident reveals

diffuse swelling around the ankle joint, slight discoloration and tenderness along all the margins of the ankle joint, back of the heel and Achilles tendon. In some cases, tenderness is most pronounced along the mesial aspect of the subastragalar joint. There is moderate impairment of mobility in the ankle and the subastragalar and midtarsal joints. The x-ray examination is negative.

In the average case, this disability lasts from ten days to two weeks. In some instances, however, a traumatic arthritis arises in the subastragalar and midtarsal joints of the foot, characterized by pain and stiffness and moderate impairment of lateral mobility. Ankle motion, however, is not materially interfered with.

This type of injury differs from an ordinary ankle sprain in the mechanism of its production. The majority of ankle sprains, as we see them, are due to eversion or inversion twists, the weight of the body acting upon the ankle, causing the sprain. In the "truckers' sprain," however, the violence is exerted from behind and it tends to force the leg off the foot in a forward direction.

Treatment: The treatment differs very little from that of the ordinary ankle sprain. The milder variety is strapped and the patient may return to work. In the

severe type, it is necessary to treat these cases as a fracture by immobilizing the foot and leg in a plaster cast, due attention being paid to a right angular and slight supinated position of the foot. At the end of ten days, the cast is removed and the extremity subjected to baking and gentle massage.

Adhesive straps are then applied which are worn for three or four days, the foot and ankle are again given baking and massage and the straps reapplied. This treatment continues for about a month. These patients usually return to work with their adhesive strapping on at the end of the second week. Pain in the heel and midfoot usually persists for some time. The average laborer, however, is not of the neurotic type and soon forgets his indisposition.

A few cases tend to pursue a chronic course characterized by pain and stiffness in the foot. Lateral motion is restricted by adhesions which have formed in the subastragalar and midtarsal regions, the foot being in rigid abduction. The x-ray may show osteoarthritic changes in these joints.

To effect a cure, I have had to resort to manipulations under an anesthetic to break down adhesions and restore normal statics. A Whitman arch brace is then made on a plaster of Paris model of the foot in the corrected position which the patient wears for an indefinite period of time.

BREECH PRESENTATION IN PRIMIPARAE*

ALEXANDER E. DUNBAR, M.D.

BROOKLYN, N. Y.

Let us review the result of five years' work at the Methodist Episcopal Hospital, 1924–1928 inclusive. In this series there are 135 cases of breech in primiparous women.

Private Cases	75
Ward Cases	60
Positions:	•
Left sacrum anterior .	72
Right sacrum anterior.	45
Left sacrum posterior.	12
Right sacrum posterior.	6
Condition of the membranes on admission:	
Intact	82
Ruptured	53

Over 50 per cent of the cases which had membranes intact, ruptured very shortly after admission to the hospital.

The shortest period of rupture before delivery 15 minutes.

The longest period of rupture before delivery 8 days.

The duration of labor varied from two hours to eight days, the average being twenty-four hours.

Types of Pelvis:		
Normal		8
Generally contracted		
Funnel		
Flat		2
Generally contracted funnel.		I
Types of Breech:		
Frank breech		11
Footling		1
Double footling .		
	*C 1 1. 10	

Procedures:	
Delivery	
(1) Spontaneous	8
(2) Breech extraction	51

The breech extraction varied from a simple pulling down of a foot which presented itself at the vulvar orifice to the most difficult procedure of pulling down one or both feet from the interior of the uterus. In two instances, extraction was performed by applying forceps directly to the breech.

Complications:	
Nuchal hitch	4
Cord between legs	2
Prolapsed cord	1
Other Maneuvers:	
Manual dilation of the cervix	
Dührssen's incisions of the cervix	
Separation of a vaginal septum	I
The Perineum:	
No laceration	3 8
First degree laceration	
Second degree laceration	11
Third degree laceration	0
Extension from lateral episiotomy	- 2
Extension from median episiotomy	~
Right lateral enisiotomy	82
Left lateral episiotomy.	[2
Median episiotomy	19

In 81.5 per cent of the cases, some type of episiotomy was used.

Forceps: The Piper type of forceps was used in the majority of the cases requiring such in the delivery of the after-coming head. In 32 cases or 23.7 per cent, forceps were required. Craniotomy was done twice in macerated feti.

In I case of this series abdominal cesarean section was employed as the procedure of election rather than of necessity.

Morbidity: There were 15 cases in this series which showed morbidity. It might be here stated that the majority of these cases were delivered before the vaginal antiseptic, mercurochrome, came really into its own. The morbidity percentage

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was 11.11 per cent and can be detailed as follows:

Mortality: Maternal: None of these mothers died as a result of this type of case.

Fetal: 17 or 12.6 per cent
Still-births
Intracranial hemorrhage
Placental separation
Maccrated fetus
Died after delivery
Intracranial hemorrhage
Gastrointestinal
Monstrosities
Spina bifida
Exisceration
Osteogenesis imperfecta.

The corrected mortality for this series is 9.78 per cent.

Six of the babies that lived showed definite signs of cerebral irritation but recovered, apparently, without any definite damage.

On investigating the reports of other clinics, we find that we are doing as well as any of them and better than most of them.

Why is the breech presentation in the primiparous woman a great problem to the obstetrician?

The breech is a soft mass which does not dilate the cervix well due to its consistency and its lack of weight. The breech predisposes to a premature or an early rupture of the membranes, thus taking away the natural hydrostatic dilator. Labor is most commonly prolonged because of these facts. While the pains may be present in frequency, they do not have sufficient power to drive the baby through the pelvis as well as the vertex. Draining off of the liquor amnii is usually greater, thereby allowing the uterus to wrap itself around the baby and thus inhibiting the progress of labor. The breech does not engage well

and we find many arrests of the breech high in the pelvis, thus necessitating delivery from that point. Particularly is this true in the cases of abnormal pelvis. We see from our study that 40 per cent of the cases require interference. The resistance of the undilated pelvic floor adds still another factor in slowing up the advance of the breech.

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When the breech has been born to the umbilicus, the cord begins to play an important part. Compression of the cord may do serious damage to the baby at this time. It is now pulled down a short way to relieve this pressure.

The arms may present further difficulty. It is hoped that these have maintained their normal relation. Valuable time may be lost if one or both arms are extended or if there is a true nuchal hitch.

The after-coming head usually presents the greatest amount of difficulty. We have here a head which has not been molded by the process of labor. It may therefore engage in the pelvis in faulty flexion, and give rise to difficult delivery.

Technique: Our policy of procedure has been one of "Hands off." Our worst enemy is the undilated cervix. When a case is progressing in a normal way and the breech presents itself, crowning, the obstetrician may assist its progress by lightly anesthetizing the patient. The perineum is thoroughly ironed out as Irving W. Potter of Buffalo, teaches. Also, if extra room is to be required, an episiotomy, preferably a lateral one, is done. The patient is allowed to recover from the analgesia and proceeds in labor until the breech is borne up to the umbilicus. The cord is then pulled down. The baby is now rotated so that the back lies under the subpubic angle. Gentle traction is made down toward the floor until the scapulae can be seen. In rotating the back under the subpubic angle, the shoulders are released, preventing the extension of the arms, or if they have not been released, they can be more readily freed from this position. Either arm may now be delivered anteriorly. If the left arm is to be delivered, the baby is rotated to the mother's left 90°. The arm will be seen to drop down under the subpubic angle. Gentle pressure in the elbow will bring down the entire arm. To deliver the other arm, the baby is rotated 180° in the opposite direction and the arm is delivered by gentle traction in the elbow.

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This brings us to the delivery of the head. It is at this point that the intelligent use of suprapubic pressure may be of value. With this aid, the finger is inserted into the baby's mouth, merely to maintain flexion and not to be used as a tractor. The body is held up with the other hand while the arms are held above it by an assistant. The body should not be extended over on to the abdomen, for fear of rupturing the falx cerebri or the tentorium cerebelli. Gradually the head is being born. By using a perineal retractor, the mouth is exposed a little sooner, and mucus can be sucked out of the mouth. This aids the child in getting air earlier and delivery does not have to be rushed.

Where the case is arrested Piper and Bachman, in a recent paper, feel that the breech should not be allowed to go along undelivered, fully realizing the difficulties of an incompletely dilated cervix. If the cervix is not completely paralyzed, it may clamp down around the neck. In order to offset this difficulty, the patient is completely anesthetized to the degree of deep surgical anesthesia. The hand is then passed up into the uterus, care being taken to keep away from the placenta and the cord. The breech is then decomposed by bringing both feet down, treating it then as a double footling. Traction is made so that when the buttocks reach the pelvic floor they are practically sitting in the hollow of the sacrum. From this point the fetus is rotated anteriorly so that the back lies up under the subpubic angle before any further traction is made. The

remainder of the procedure is as before described.

In 3 of the 32 cases in which the Piper forceps were used we found that the babies died, one as a still-birth and two died within a few days after delivery, as a result of an intracranial hemorrhage. In 2 other cases we found two babies that presented signs of cerebral edema. Piper and Bachman feel that their specially devised instrument should be routinely used, fully realizing that the said forceps are of little or no value if the after-coming head is arrested above the pelvic brim. I do not believe that any type of forceps should be used routinely in the treatment

of the after-coming head.

In our clinic we have felt that the policy of "Let nature take its course" is the wisest one. We have not used hydrostatic bags, bougies or other means to hasten the labor in women who have a breech presentation and are having a prolonged labor. Our greatest fear is undilated cervix. By "keeping hands off" we feel that our results compare favorably with those of other clinics. In prophylaxis of this situation we have felt as J. O. Polak says, "it would have been a head if it could have been a head." We therefore have not adopted external version as a prophylactic measure.

Conclusion:

(1) Hands off the breech.

(2) Our worst enemy is the cervix. Give it time to dilate.

- (3) Cases of markedly abnormal pelvis with oversized babies, and elderly primiparae should be treated by cesarean section.
- (4) Where there has been an arrest after full dilation patients should be surgically anesthetized, the soft tissues thoroughly dilated, plus episiotomy and a careful extraction should be done.
- (5) Breech cases should at all times be in the hands of the trained obstetrician.

PORRO CESAREAN SECTION

(CESAREAN SECTION FOLLOWED BY SUPRAVAGINAL HYSTERECTOMY)
A REVIEW OF 25 CONSECUTIVE CASES WITHOUT MATERNAL MORTALITY*

Louis E. Phaneuf, M.D., f.A.C.S.

BOSTON

ACCORDING to Williams, the history of cesarean section may be said to cover five distinct periods. The first period dates from the earliest times to the beginning of the sixteenth century. The second period extends from 1500 to 1876. The third period begins with the introduction, by Porro, of the amputation of the body of the uterus. The fourth period starts in 1882 following the description, by Saenger, of an accurate technique for suturing the uterine incision and continues to the present time. Finally the fifth period saw its origin when Frank devised the extraperitoneal technique.

During the first two periods, cesarean section was only done when all other methods of delivery had failed, as a result of which the mortality was frightful. This high mortality was due to sepsis or hemorrhage or both. In order to lessen these disastrous complications, Porro, of Pavia, in 1876, advised the amputation of the body of the uterus and the adnexa above an elastic ligature, wound around the cervix and the suturing of the cervical stump at the lower angle of the abdominal incision. DeLee,2 states that the operation had been suggested by Cavallini in 1768 and performed successfully on rabbits by Blundell in 1823. Storer of Boston, in 1861, amputated a pregnant myomatous uterus with fatal result. Inasmuch, however, as he did not appear to recognize the importance of this intervention, the credit for proposing it undoubtedly belongs to Porro. Later, when Schroeder dropped the sutured hysterectomy stump back into the pelvis, Isaac E. Taylor did the same for the stump after Porro's operation.

With the advent of the Porro operation the mortality of cesarean section was Williams. Obstetrics. Ed. 6, N. Y., Appleton, 1930,

pp. 530-533.

² DeLee. Principles and Practice of Obstetrics. Ed. 5.
Phila., Saunders. 1929, pp. 1071-1073.

greatly reduced. Its great drawback was that it was so radical. When, in 1882, Saenger described his technique of suturing

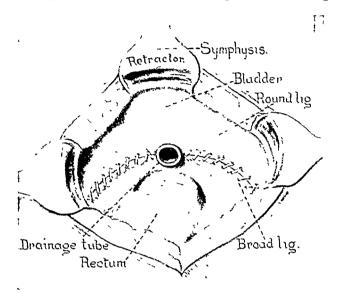


Fig. 1. Porro cesarean section completed. In this case the adnexa have been removed. Round ligaments have been sutured to cervical stump. Rubber drainage tube has been introduced in cervix. All raw areas in pelvis have been covered with peritoneum.

the uterine incision, he made one of the greatest, if not the greatest contribution to cesarean section. Saenger's operation was responsible for limiting the Porro procedure to those cases where a definite indication for sacrificing the uterus existed.

The contribution of Frank, when he advocated the extraperitoneal technique, still further limited the indications for the radical method of Porro.

The present-day indications are (1) sepsis in labor when vaginal delivery is undesirable, (2) in the presence of myomata, especially if large or situated ahead of the presenting part thus obstructing labor, and (3) in severe hemorrhage from placenta previa, ablatio placentae and uterine apoplexy, "Couvelaire uterus." (4) Cancer of the cervix, osteomalacia, placenta accreta, uncontrollable post-partum hemorrhage and rupture of the uterus are rarer indications for hysterectomy.

* Submitted for publication March 6, 1931.

No. of Pregnancies Para I..... II...... Ш..... IV..... v..... XI..... Total..... 25 Indications Mismanaged labor and frank infection..... Uterine myomata..... Pathological uterus from improperly healed previous classical cesarean section scars..... Uncontrollable hemorrhage during cesarean section Premature separation of placenta and uterine apoplexy..... Firmly adherent placenta, anterior uterine wall thinned out to peritoneum, 4 previous manual extractions of placenta..... Hernia of gravid uterus, previous classical cesarean section, edges of incision held only by peritoneum Total..... 25 Labor

Ten of the gravid patients had had labor. 64 hours, 1; 48 hours, 2; 25 hours, 1; 18 hours, 1; 16 hours, 1. In labor for many hours, the exact number not determined 4.

Vaginal Examinations

Several vaginal examinations had been made in 4 of the patients. In one a bag had been in the uterus five hours; in another, there had been seven attempts at forceps before admission.

Transfusion

Two patients in the series were transfused, one for hemorrhage was given 600 c.c. of citrated blood, the other for anemia of pregnancy was given 400 c.c.

Ruptured Membranes

The membranes were ruptured in eight patients, the longest being seventy-two hours.

Maternal Results

All the mothers recovered. The postoperative complications were: two very septic incisions breaking down to the fascia in 2 infected cases; these patients were discharged with healed incisions. There was superficial sepsis around the abdominal drains in the drained cases; these cleared up readily after the removal of the drains. One patient had a pelvic abscess drained twenty-five days after operation by posterior colpotomy. The original operation had been done for a fibroid previa in a clean case and the cervix and abdomen had been closed without drainage. The convalescence was remarkably simple in this series of cases despite the fact that many of the patients were poor risks.

Fetal Mortality

Twenty-five children were delivered, 3 were dead before the operation was undertaken and 1 born alive did not survive, a gross fetal mortality of 16 per cent. Of the 22 children born alive 1 died, a corrected fetal mortality of 4.5 per cent.

and u Cerebra Fetal D Died on ease a	had separat terine apopl I injury; 7 at eath—I the fifth da and infection four hours, f	ion of the place exytempts at forcepy, hemorrhagic Septic case, la	2 os 1 dis- bor	
	Anest			
Spinal a	nesthesia		4	
Nitrous	oxide, ether	anesthesia	21	
	Type of H	ysterectomy		
Panhyst	••		r	
Suprava	ginal hyster	ectomy	24	
Ouprava		nexa	-	
_			_	
Conservation of both adnexa 9			9	
	Conservation of right adnexa I			
Ablation of both adnexa 15			15	
	A	ges		
Years	No.	Years	No.	
22	2	3 <i>5</i>	2	
23	1	3 6	2	
29	2	37	2	
30	2	38	1	
31	1	40	3	
33	2	42	I	
34	3	44	I	
Total 25				

SUMMARY AND COMMENT

While it should be the aim of the gynecologist and obstetrician to conserve the organs of reproduction during the childbearing age, there are certain conditions arising during parturition which may threaten the mother's life and which demand their sacrifice. With the improvement in the technique of cesarean section, especially since the more general adoption of the low or cervical procedure, the indications of the Porro operation have become greatly limited. Despite this fact, there will probably always be an occasional case when this method is a life-saving one. Twenty-five consecutive Porro cesarean sections are reported, without maternal mortality, with a gross fetal mortality of 16 per cent and a corrected fetal mortality of 4.5 per cent. The technique of the operation is simple. Drainage, through the cervix, seems advisable, even if not absolutely necessary, in most cases. The convalescence is remarkably simple when we take into consideration that this operation is usually done on septic women, and on those who have lost considerable blood.

PRIMARY STRICTURE OF THE COMMON BILE DUCT (NON-MALIGNANT)

Louis Friedman, M.D.

NEW YORK

PRIMARY inflammatory stricture of common bile duct is comparatively rare, of the hepatics more so, though

not vertical as is the tendency to do, so that the tube emerges at the lower angle of the wound not at the upper angle. It is



Fig. 1.

Fig. 2. Lipiodol in sinus tract. Stomach, duodenum, liver radicals.

Eliot quotes statistics from the Mayo Clinic which showed that 18 of 38 cases had no primary operations.

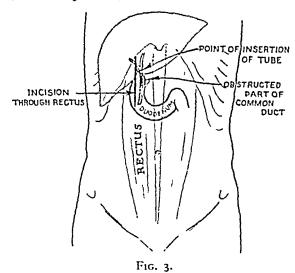
The operative management, where plastic reconstruction of the common bile duct is not feasible either in primary stricture or postoperative injury, is as follows: Preoperative preparation of patient for the existing cholemia. Spinal anesthesia preferable. Exploration. Finding of stricture or injury to common bile duct, introduction of drainage tube (14-15) French size) into dilated portion of common bile duct above the stricture. It is important in instituting this drainage that the tube used shall be as nearly horizontal to the axis of the spine as possible,

important to keep away from the liver or gall-bladder bed if this has to be removed, as far as possible so that the subsequently formed biliary sinus tract shall have no liver substance as part of its wall.

The only portion of the fistulous tract which can be utilized and cored out for anastomotic implantation is that portion extending from the skin surface to and only very little distance beyond the peritoneum. It is inadvisable to attempt to separate the fistulous tract beyond the peritoneum for the reason that in attempting to do so injury to the sinus tract may be done in separating adhesions. If the liver is a part of the sinus tract, care must be taken in dissecting and coring out the tract; the

^{*} Sabmitted for publication December 6, 1930.

slightest nick in its attachment to the liver, part of the tract, will result in partial (as in my case) or total failure due to



subsequent leak and bile drainage. The tract should be cored out with as much thickness of surrounding structures as possible so helping its blood supply as well as its rigidity. The fistulous tract is usually not long. In the case here reported, it was not longer than $\frac{3}{4}$ in. Difficulty in implanting can be avoided by having a longer tract. In order to obtain this, it is necessary to place the drainage tube horizontal to the body axis and then following the suggested steps for the formation of the sinus tract, part of the wall of which will be fascia, as illustrated.

The time for performance of the second stage of the operation, that is, the implanting of the sinus tract, will depend upon the judgment of the surgeon and the general condition of the patient. Primary union of the wound is essential for a subsequent well-formed tract. The patient should be entirely free from jaundice, Van den Bergh test normal, and the patency of the sinus determined, by withdrawing the drainage tube after healing of wound, allowing bile drainage without tube for a week or ten days. In coring the sinus, allow at least 14 in. of skin surface with the sinus, to act as a retention catheter would.

CASE REPORT

Julius Miller. No. 6044. Age, sixty-four. Chief Complaint: Jaundice.

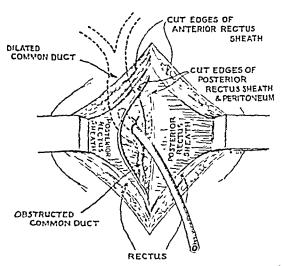


Fig. 4. Step 1. Insertion of tube into dilated portion of common duct above stricture.

Family History: Negative. Past History: Negative.

Present Illness: Jaundice for four weeks; onset gradual, not associated with pain; no fever; some belching; nausea but no vomiting. Stools became clay colored and urine consistently darker. Increasing jaundice, severe itching.

Physical Examination: Patient is an adult white male, sixty-four years of age, Skin jaundiced. Sclerae jaundiced. Eyes: Pupils equal, regular, react well. Heart: Normal. Lungs: Normal. Abdomen: Liver palpable four finger breadths below costal margin. Spleen not palpable. Kidneys not palpable.

Impression: Carcinoma of pancreas?

Admitted to Medical Ward for observation and later transferred to Surgical Service under the care of Dr. Friedman who found the patient deeply jaundiced. Mass in right hypochondrium, somewhat tender, suggestive of distended gall bladder. Diagnosis: cholecystitis. Cholangitis and possible carcinoma of head of pancreas. Advised operation.

Operation, Sept. 25, 1928: the abdomen was opened by a right upper quadrant incision. Gall bladder found to be distended, containing white bile. In other words, hydrops of gall bladder. Cholecystectomy. Cystic duct was found to be obliterated and this obliteration continuous with the common bile duct giving

the impression of a stone in the common bile duct. Incision, however, of this mass proved that it was only hard cicatricial tissue which

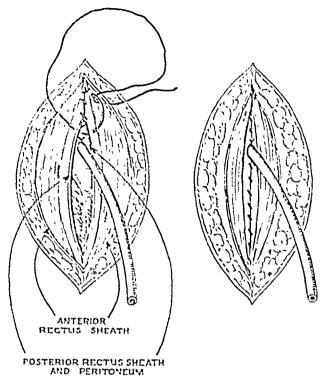


Fig. 5. Step 2a. Suture peritoneum and posterior rectus sheath. Note horizontal portion of drainage tube. b. Peritoneum and posterior rectus sheath closed.

fine probe through the constricted common bile duct and into duodenum was not successful. The duct above the constriction was opened and bile obtained under great pressure. Tube introduced into common bile duct above constriction for drainage. Usual closure of abdominal wound.

Postoperative course uneventful. Patient began to drain bile after a number of hours through the tube. Jaundice gradually cleared up.

Urinary Examinations:

Sept. 10, 1928. Specific gravity 1028. Bile in urine. Trace of albumin. Trace of urobilinogen. Few casts.

Sept. 11, 1928. Bile 2+.

Sept. 10, 1928. Blood count, red blood cells 4,320,000. Hemoglobin, 80 per cent. White blood cells 6000. Coagulation time five minutes. Bleeding time two minutes.

Urea N. 16.2. Glucose 160. Van den Bergh indirect 8, direct 8.

Sept. 11, 1928. Wassermann test negative. Gastric contents, blood negative. Bile negative.

Sept. 12, 1928. Van den Bergh Indirect 9.0. Direct 4+.

Sept. 13, 1928. Cholesterin 167. Gastric contents: bile present in both specimens.

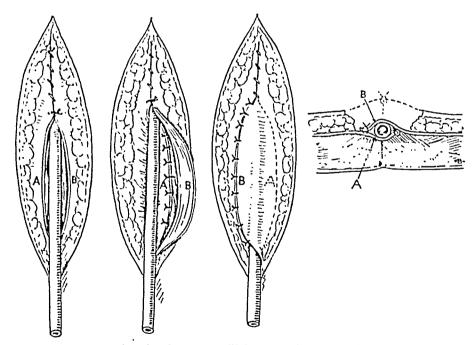


Fig. 6. Step 3. Method of constructing fistula tract utilizing anterior rectus fascia. Mobilize fascia, by dissecting from rectus muscle; avoid tension. Use chromic catgut.

caused complete obstruction of common bile duct with considerable distention of the duct above site of constriction. Attempt to pass a

Sept. 14, 1928. Bile before magnesium sulphate 3. After magnesium sulphate. Van den Bergh indirect 6. Direct 3+.

Sept. 17, 1028. Van den Bergh indirect 4. Direct 3.

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Sept. 19, 1928. Gastric contents, bile 4+ in

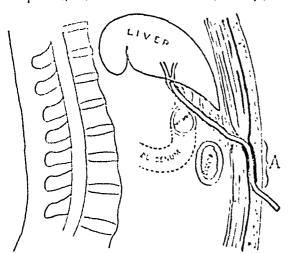


Fig. 7. A. Extent of channel made from anterior rectus fascia. Length depending on individual judgment. Showing drainage tube as nearly horizontal to body as possible; staying away from liver bed.

both specimens. Blood chemistry: Van den Bergh indirect 4. Direct 2+.

After drainage instituted.

Oct. 4, 1928. Van den Bergh 2.3. Direct 1+. Oct. 11, 1928. Van den Bergh indirect 1.5. Direct negative.

Oct. 29, 1928. Urea nitrogen 21. Creatinine 1.5. Glucose 130.

X-ray examination Sept. 17, 1928. Gall bladder with dye after twelve, fifteen and eighteen hours not visualized. Thirty-six hour examination after fatty meal did not visualize gall bladder.

Pathological Examination: Sept. 25, 1928. Specimen consists of a gall bladder $8 \times 3 \times 3$ cm. Wall quite thickened, filled with scattered cysts. Mucosa is thickened, reddish and yellowish in color; shows areas of brownish discoloration at fundus.

Histological Examination: section shows almost complete atrophy of mucosa, thick fibrous connective tissue through. Thickened vessels with moderate edema.

Diagnosis: Chronic productive cholecystitis. The patient left the hospital with a biliary fistula. Reentered the hospital again Jan. 31,

Physical Examination: Patient fairly well nourished, not jaundiced. Abdomen: has persistent biliary fistula, otherwise no pain anywhere.

Operation: Feb. 8, 1929. Under spinal anesthesia, fistulous tract was dissected down to peritoneum. Fistula was inadvertently nicked

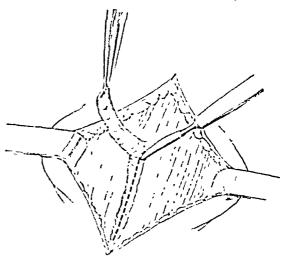


Fig. 8. Step 4. Second operation. Coring out fistula tract for implantation.

at its contact with the liver. It was immediately sutured with chromic catgut. The duodenum was buried in dense adhesions and because of shortness of biliary fistula it was deemed advisable to implant it into the stomach rather than into the duodenum. The stomach was delivered, opened, postpyloric. Tract was placed into the opening, first sutured posteriorly then anteriorly with interrupted silk. Omentum was used to cover anterior sutures. Piece of rubber dam placed posteriorly and abdomen closed.

Postoperative progress fairly normal. First dressing Feb. 12, 1929. Rubber dam drain removed. Slight amount of serous discharge present.

Feb. 13, 1929. Van den Bergh indirect 1.4. Direct negative.

Feb. 18, 1929. Convalescence normal.

Feb. 22, 1929. 4 P.M. Patient had chill. Temperature 103°F. Considerable râles in chest. Stool good color.

Feb. 26, 1929. Wound inspected. All sutures removed. Primary union of wound. Fistula anastomosis evidently working well. Stools yellow. Sclerae very slightly icteric. Van den Bergh normal. Patient out of bed.

March, 1, 1929. Temperature 101°F. Moderate tenderness in upper angle of wound.

March 2, 1929. Upper angle of wound reopened. Slight amount of bile appeared on dressing, most likely coming from that part of sinus tract which was nicked at time of operation. Following this from time to time considerable bile discharged from wound.

March 19, 1929. Biliary fistula draining just as much as before operation. Patient somewhat better. Lipiodol injected and x-rays taken.

Lipiodol injected and x-rays taken. X-rays show primary biliary fistula implantation open and functioning. The lipiodol is seen to be present in the stomach.

Until the patient left the hospital biliary drainage through this fistula stopped and started on and off several times.

March 9, 1929. Bile drainage has ceased since last Friday. Previously drainage has been very slight. Stools are vellow since drainage stopped.

Readmitted Jan. 30, 1929. Stools acholyc. Second operation Feb. 8, 1929.

Feb. 9, 1929. Vomited large amounts of green fluid. Stool yellow.

Feb. 13, 1929. Stool yellow. Postoperative showing fistula anastomosis functioning.

Feb. 14, 1929. Stool yellow. Postoperative showing fistula anastomosis functioning.

Feb. 19, 1929. Brown formed stools. Postoperative showing fistula anastomosis functioning.

Feb. 22, 1929. Yellowish brown stools. Postoperative showing fistula anastomosis functioning.

Feb. 28, 1929. Yellowish brown stools. Postoperative showing fistula anastomosis functioning.

March 1, 1929. Following chill, vomited yellowish green fluid, like bile. Fistula draining

March 5, 1929. Stool light brown.

March 8, 1929. Stool light green. Fistula draining very little.

March 9, 1929. Stool brown.

March 11, 1929. Stool light brown. Fistula draining.

March 12, 1929. Stool light brown. Fistula draining.

March 13, 1929. Stool very light. Fistula draining.

March 14, 1929. Stool very light. Fistula draining.

March 18, 1929. Stool light brown.

March 20, 1929. Stool light yellow.

March 22, 1929. Free drainage. Bile salts three times a day.

March 24, 1929. Stool light brown.

March 26, 1929. Stool dark brown. Drainage moderate.

March 27, 1929. Stool dark brown.

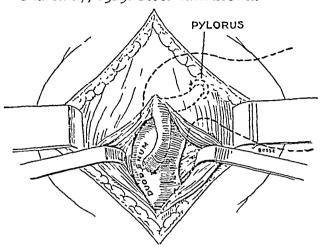


Fig. o. Second operation. Implantation of fistula tract either into pylorus or duodenum. Witzel method.

March 28, 1929. Stool yellow.

March 29, 1929. Stool-light greenish.

April 2, 1929. Stool light brown.

April 30, 1929. Stool clay color.

X-ray examination, March 14, 1929, of abdomen after injection of sinus tract with iodized oil shows the following: The oil is entering the hepatic ducts with some oil entering the duodenum and stomach.

Comment. It is interesting to note that for almost three weeks the fistula was functioning with bile entering into the stomach and duodenum as proved by the color of stool. If not for the unfortunate accidental nicking of fistulous tract at its junction with the liver bed, secondary biliary fistula would not have formed and anastomosis with proper bile drainage into the stomach would have been possible. It is also interesting to note that during the periods of closure of fistula which occurred from time to time following the operation, the stools again became colored as per dates mentioned proving again that the fistula gastric anastomosis was functioning. However, later the drainage of bile continued through the fistula in the abdominal wall and because of the condition of the patient it was not advisable to operate so he was discharged.

August 2, 1929. X-ray examination of biliary fistula injected with lipiodol showed the following: Moderate number of biliary ducts to be filled. There are two small dilatations, one measuring about 34 in. in length and the other ½ in. seen in the region of the common duct. Lipiodol passes readily into the duodenum.

Patient died Oct. 7, 1929.

INFLAMMATORY OBSTRUCTION OF THE URETER

CAUSED BY PSOAS ABSCESS, SECONDARY TO TUBERCULOSIS OF THE SPINE* GILBERT J. THOMAS, M.D., F.A.C.S., AND THOMAS J. KINSELLA, M.D., F.A.C.S.

MINNEAPOLIS, MINN.

OAK TERRACE, MINN.
time this sinus closed, and then a kyphosis

AT Glen Lake Sanatorium, the Hennepin County institution for the treatment of tuberculosis, new data concerning the diagnosis and treatment of tuberculosis, together with many unusual pathologic specimens, are reported each year.

Patients sent to Glen Lake Sanatorium, where all types of tuberculosis are treated, sometimes remain for many years. This permits us to make repeated examinations, and to watch lesions in the genitourinary tract over long periods of time. In an attempt to evaluate our clinical findings and data obtained from urologic study, a post-mortem examination is made, whenever possible. Gross specimens of the urinary organs are always saved for study, whether the patient has had genitourinary symptoms or not. This routine post-mortem examination of the urinary organs has been enlightening.

We are reporting herewith the histories and post-mortem findings of two patients who had obstructions in their ureters which were the result of psoas abscesses originating in tuberculosis of the vertebrae. The obstruction was complete enough to destroy the kidney entirely in one instance, and to produce a large hydronephrosis in the other. In neither was the unusual pathology suspected, and would not have been discovered without a post-mortem examination.

CASE REPORTS

Case 1. A woman, aged thirty-nine years, whose history indicates that at the age of twenty-one she had her first illness, an abscess developing over the spine. This opened spontaneously, but drainage was not sufficient and eventually a rib resection was done. For a

developed.

No trouble was observed for three years. Then she complained of pain in the right side of the back with some radiation to the right abdomen. The patient had an appendectomy which gave no relief from this pain, and left a gaping, infected wound which did not heal for several months.

During the patient's convalescence from the appendectomy, another abscess developed in her back which required multiple incisions in order to improve the drainage. Chronically draining sinuses resulted which continued for many years.

In September, 1927, the patient had a severe cold, followed by a persistent cough. This continued until her admission to the sanatorium in April, 1928. At this time a thorough examination revealed the following lesions: (1) tuberculosis of the sixth to the twelfth dorsal vertebrae, with draining tuberculous sinuses from the right posterior chest wall; (2) pulmonary tuberculous with empyema, right side; (3) some free fluid in the peritoneal cavity, probably peritonitis.

Repeated inoculations of the urine into guinea pigs were negative for tuberculosis.

Post-mortem examination, made two years following the patient's admission to the sanatorium, revealed the following: There were several sinuses, one about 3 cm. below the right nipple, another 8.5 cm. below the crest of the left ileum and 10 cm. posterior to the anterior superior spine. There were five scars of healed sinuses in the skin of the back.

An old pulmonary tuberculosis with empyema was found in the right chest. A chronic tuberculous peritonitis was present and there was a tuberculosis of the fourth dorsal to the third lumbar vertebrae with multiple sinuses. The right kidney, which was normal in size and weight, was bound down by firm fibrous adhesions. These were noticeable on the medial and anterior portions. Except for these

^{*}Read at the 42nd Annual Meeting, American Association of Genito-Urinary Surgeons, French Lick, Ind., May 22-24, 1930.

adhesions, the right kidney and ureter seemed to be normal.

On the left side there were many adhesions

On admission we found that this man had a bilateral parenchymal pulmonary tuberculosis, more noticeable on the right side than on the

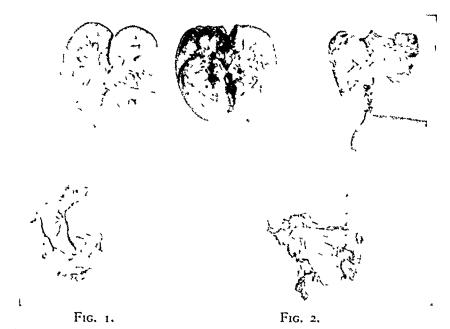


Fig. 1. Hydronephrosis produced by obstruction in upper ureter, result of psoas abscess.

Fig. 2. Kidney totally destroyed. Hydronephrosis with obstruction in ureter near kidney the result of psoas abscess, opposite kidney normal.

which involved the entire kidney and the first 4 cm. of the left ureter. This kidney was markedly atrophic. There was a hydronephrosis which was produced by contraction of scar tissue about the upper ureter. Inspection of the left ureter below the obstructed area was negative. There was no gross or microscopic evidence of tuberculosis in either kidney. A sinus tract was discovered on the left side which began at the eleventh dorsal vertebra and extended to the scar tissue surrounding the left upper ureter and kidney. This was followed laterally and was lost over the left psoas muscle.

We reviewed the nurse's record and the patient's complaints appearing in the history and progress record without finding mention of attacks of pain which might be interpreted as coming from some condition obstructing the left ureter. Since this patient had back pain continuously because of the tuberculosis of the vertebrae, it is easy to understand why this symptom may have been misinterpreted.

Case II. The second patient was a male, aged twenty years, who was admitted to the sanatorium April 22, 1927, and died August 31, 1927, berng under our observation for only four months.

left. He had a positive sputum. Two months after admission he had a contracture of the left thigh and a palpable mass in the left abdomen. For several weeks before this abdominal mass was noted, the patient had complained of pain in the left leg and the left lumbar region. He had no genitourinary complaints. Urinalysis of ten specimens of urine revealed only a faint trace of albumen. Only one contained a few leucocytes. Repeated Ziehl-Neelson stains and frequent injections of urine into guinea pigs did not reveal evidence of tuberculosis.

A roentgenogram of the lower dorsal and lumbar spine showed marked destruction of the lower portion of the first and third lumbar vertebra with bilateral psoas abscess.

A post-mortem examination was made one hour following death. The anatomical diagnoses were Pott's disease of the lumbar spine, miliary tuberculosis of the lungs, kidneys and adrenals, with caseous tuberculosis of the lungs and adrenals. There was slight dilation of the pelvis of the right kidney and there were many tubercles scattered throughout its cortex. The ureter on the right side was not involved in an inflammatory mass. On the left side there was marked dilatation of the pelvis of the kidney. The ureter was caught in a fibrous

tissue mass which was part of a psoas abscess constricting the ureter and producing a hydronephrosis.

A review of this patient's history does not reveal complaints, symptoms or findings which might indicate a genitourinary lesion. Like the former patient, this man had a great deal of pain on the left lumbar region which extended downward, and which we believed was produced by a large psoas abscess. If this patient had pain as a result of obstruction in his ureter, it probably was masked by the pains which were produced by the tuberculosis in the spine and the psoas abscess. We do not know why the abscess on the right side did not involve the right ureter. We are unable at this time to find an anatomical reason why the left, and not the right ureter should be involved,

particularly in the last case, where bilateral psoas abscess were discovered.

It seems evident from these reports that psoas abscess may involve the ureter, producing obstruction and thus destroying the kidney. In the cases which we report, this obstruction in the ureter was not associated with tuberculosis of the kidney. Urinary findings were negative. The history was not helpful in making a diagnosis of ureteral obstruction.

The conditions found had not been anticipated, and only the post-mortem study made the true diagnosis possible. We shall consider, however, the possibility of obstruction of the ureter in all future cases of psoas abscess.

These reports are made with the cooperation of Drs. C. C. VanWinkle and L. E. Williams, pathologists at Glen Lake Sanatorium, who made the post-morten examinations and obtained the specimens.



DISEASES OF THE GALL BLADDER AND BILIARY TRACT

CLINICAL AND SURGICAL ASPECTS*

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LOS ANGELES, CALIF.

THAT the gall bladder is not indispensable has been established by the excellent results obtained following cholecystectomy for disease confined to that organ. However, it is not to be assumed on this basis that the normal gall bladder is not indispensable to the best functional activity of the biliary apparatus. In general, the results of cholecystectomy have been best when existing disease confined to the gall bladder has disturbed most markedly the function of the gall bladder. In other words, there is minimum disturbance of biliary function following cholecystectomy for a functionless organ in the absence of extension of cholecystic disease to the biliary tract. Postoperative disturbance of a variable degree has at times persisted following cholecystectomy for definite cholecystitis with or without stones, when such disease has not previously interfered with the function of the gall bladder. Just why such biliary disturbance should be encountered postoperatively in the absence of extension of the primary cholecystic disease to the remainder of the biliary tract has not been adequately explained. Some years ago, Mann and Judd showed experimentally that following cholecystectomy, dilatation of the bile ducts and overthrow of the sphincter activity of the ampulla, with resultant loss of pressure in the bile flow, occurred, and that the flow of bile was more or less continuous into the intestinal tract, as in animals in which normally the gall bladder is absent. In some individuals it would appear that this constant flow of bile into the intestinal tract is not always tolerated. However, that constant flow of bile into the intestinal tract is usually well tolerated is shown by the absence of disturbance following the

so-called sidetracking or shortcircuiting operations for permanent biliary obstruction, when an anastamosis is made between the gall bladder and the stomach or duodenum.

The gall bladder and biliary apparatus are so intimately associated with the liver and its functions, and the pancreas, that the results of operations on the gall bladder and biliary tract are often dependent upon the restoration of function of an impaired liver. This is particularly true when there has been associated common duct disease or obstruction and jaundice.

Disturbance of function of the liver secondary to gall-bladder disease is usually the result of infection or bile retention, or both. The peculiar markings of the surface of the liver so frequently observed in that organ directly adjacent to the gall bladder, to which area it is often grossly confined, have given rise to much speculation as regards its relation, if any, to cholecystic disease. The term "localized hepatitis" has been applied to such findings, and the condition has become of considerable significance to surgeons in determining whether or not disease really exists in the gall bladder in the absence of the otherwise easily recognized gross manifestations of cholecystic disease. A variable degree of localized hepatitis is found in many cases of cholecystic disease, and while the extensiveness of such hepatitis is indicative of the degree of cholecystic disease, considerable thickening of the capsule of the liver, with subcapsular deposit of fibrous tissue, has at times been observed when little if any cholecystic disease existed, as shown by careful examination of the gall bladder after its removal. In extensive cholecystic disease

^{*} Read before the Los Angeles Surgical Society, October 10, 1930.

of long standing, localized hepatitis often has advanced to the degree of considerable scarring, thickening and deformity of the liver edge. Mentzer has shown that this change, while most marked about the gall bladder, occurs diffusely throughout the organ. It is only with secondary involvement of the biliary tract attending obstruction, with or without infection, that liver function may be seriously impaired.

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Judd has very accurately described the difference in the changes which occur within the liver subsequent to obstruction without infection, those that occur in the presence of infection without obstruction, and those that occur subsequent to obstruction with infection. The best example of the changes which occur in the liver as the result of obstruction without infection is the condition produced in carcinoma of the head of the pancreas, involving or occluding the common bile duct. Corrosion specimens of the liver, as prepared by the method of Counseller and McIndoe, show enormous dilatation of the ducts, with clubbing of their ends. So far as the liver tissue is concerned, a true biliary cirrhosis occurs.

In the presence of infection without obstruction, as seen in cholangitis with or without common duct stones, the changes in the liver tissue are not nearly so marked as in those cases of obstruction with or without infection. So far as the biliary tract is concerned, even though great dilatation of the common duct is observed in some instances of infection associated with common duct obstruction by stone, the corrosion specimens rarely show extreme dilatation of the ducts within the liver. This has been explained by the incompleteness of the obstruction by stones, with intermittent periods of bile flow into the intestinal tract.

Mann and his co-workers, in their investigative work on the physiology of the liver and its functions, have contributed information of practical clinical significance with reference to liver damage

resulting from cholecystic disease. Mann has shown that subsequent to the removal of the liver in the experimental animal there is a marked decrease in the blood sugar and cessation of urea formation, with an accumulation in the tissues of a yellow pigment which gives a positive reaction for bilirubin, indicating that the liver has to do with the formation of urea; that it is a storehouse for carbohydrates; that it maintains a fairly constant blood sugar level, and that it excretes bile pigment. Furthermore, Mann and his co-workers have shown that when cirrhosis of the liver has been produced in the experimental animal by the injection of carbon tetrachloride, a diet consisting largely of protein is fatal within a few days, while life may be prolonged indefinitely on a high carbohydrate diet. These observations have proved of great value in their clinical application to patients in whom extensive liver damage has occurred incident to cholecystic disease with involvement of the biliary tract. The preoperative and postoperative restriction of proteins and the use of a high carbohydrate diet have become most important in the treatment of patients with cholecystitis and disease of the biliary tract, amenable to surgery, and impaired liver function. It is immediately manifest that appreciable disturbances in liver function exert a profound influence on the general and total metabolism of the body, and inasmuch as cholecystic disease is an exceedingly frequent cause, with its subsequent biliary complications of hepatic insufficiency, cholecystitis may hardly be considered as a local disease, confined in its effects to the gall bladder and adjacent structures.

Clinicians, surgeons and pathologists have long speculated on the etiology of cholecystitis, and much investigative work has resulted in establishing a number of etiologic factors without definitely determining the exact cause. Unquestionably infection plays a most important rôle in the etiology of cholecystitis. However,

cultural studies of the gall-bladder wall, bile, and stones have failed to give a high incidence of positive cultures. Churchman, after extensive investigation of the infection theory, concluded that the pathologic condition in many cases must be due to changes in the blood vessels and causes other than those of bacterial invasion. Mentzer suggested that the lipoid deposits in the gall bladder, as seen in cholesterosis, or the so-called "strawberry cholecystitis," are evidence of the part the gall bladder plays in the metabolism of fat. Whether or not infection is a primary etiological factor, it becomes of utmost importance with the progressive changes that occur coincidental to cholecystitis and biliary tract disease.

The clinical manifestations of gallbladder disease, when clinical symptoms are exhibited, are fairly definite and quite universally appreciated. However, extensive cholecystic disease at times develops as a more or less silent process so far as subjective data are concerned, and at times a most indefinite history only can be obtained. The silent pathological gall bladder and those in which indefinite symptoms are exhibited have been most elusive diagnostically until the advent of the Graham-Cole methods of cholecystography. Unquestionably, cholecystography has contributed most brilliantly to the diagnosis of gall-bladder disease, not necessarily as a method of depicting the absence or presence of pathology in the gall bladder, but in ascertaining function of the structure. Cholecystography is primarily a test of the dye-concentrating ability of the gall bladder, and, excepting in cases of stone, not a means of demonstrating pathologic changes directly. Unless disease of the gall bladder interferes with its function, cholecystography, except when depicting stones, may fail entirely in establishing a diagnosis of pathology. Definite disease does not always diminish the capacity for concentration of the dye, nor, as shown by Kirklin, Caylor, and Bollman, is the relation constant between

the degree of concentration of bile and that of cholecystographic mediums. Cholecystography possesses its maximum value when the roentgenologist's interpretations, in terms of function, are appraised in relation to the history and other clinical factors. Kirklin has recently reported the general accuracy of 90 per cent of all cholecystographic diagnoses at the Mayo Clinic. The greatest error occurred in that group of cases in which the roentgenologist reported a normally functioning gall bladder without stones at operation. Cholecystography was found to be in error in 18.5 per cent of the cases. It is of interest that in the group of cases in which gallstones were found at operation, they were manifest as dense or translucent areas and diagnosed as gallstones in but 40 per cent of the cases, which is a higher incidence of the roentgen evidence of stones than could be relied upon prior to the modern methods of cholecystography. A negative and positive value may be placed on cholecystography when considered in conjunction with the history and other clinical data. A positive interpretation of poor or non-function with or without stones bolsters very materially a poor history. A positive interpretation in conjunction with a good history is simply corroborative, while a negative interpretation, with normal function shown by cholecystography, provides strongly supportive evidence of the absence of cholecystic disease with a poor or indefinite history. While the function of the gall bladder is more or less undetermined, it is too important a structure to be sacrificed needlessly, and a poorly functioning gall bladder without stones, as determined by cholecystography, in the absence of a history suggestive of cholecystitis, is insufficient evidence to condemn the gall bladder surgically.

So far as clinical manifestations of cholecystitis are concerned, I wish to discuss very briefly the clinical significance of jaundice. Little question exists regarding its significance in the truly obstructive lesions whether by stone stricture or American Journal of Surgery

malignant disease. Formerly the diagnosis of cholecystitis was arrived at rather reluctantly unless a history of jaundice could be elicited. Experience has shown that cholecystic disease confined to the gall bladder is seldom accompanied by any degree of jaundice except in the acute process, with stones obstructing the cystic duct or neck of the gall bladder, resulting in cystic distention or empyema with pericystic inflammatory reaction and glandular enlargement, producing variable degrees of extrinsic pressure upon the common duct. However, the presence of jaundice or an antecedent history of jaundice immediately directs attention to the common duct, and extrinsic obstruction cannot be assumed until intrinsic obstruction has been excluded at operation. The advisability of exploration or careful examination of the common duct for intrinsic obstruction is apparent in all cases in which jaundice is present or has existed. Likewise, it should not be assumed because jaundice has never existed that stones or infection are not present in the common and hepatic ducts. It has previously been stated that following cholecystectomy in the experimental animal there is dilatation of the ducts, with loss of sphincter control at the ampulla. Unquestionally, in many humans some dilatation of the ducts occurs, but frequently I have observed in secondary operations subsequent to cholecystectomy very little if any demonstrable dilatation of the common duct. Also, in many instances, when the gall bladder is contracted down on stones and cholecystographic examination shows that no bile enters the gall bladder, and so far as function is concerned there has been a pathologic cholecystectomy, very little if any dilatation of the common duct is found in the absence of common duct stones. The point that I wish to make and emphasize is that in operations for cholecystic disease when undue dilatation of the common duct exists, even though there has not been a history of jaundice and no stones

can be felt in the common duct, such undue dilatation, except in the presence of contraindication, indicates the advisability of incising the common duct and exploring for common duct stones. I have many times removed stones from the common duct when they had previously not been suspected. It is true that at times such exploration is accompanied by negative findings. However, experience has shown that under just such circumstances exploratory choledochotomy is productive of single or multiple migratory stones in the common hepatic ducts in more than 50 per cent of the cases.

I have recently reviewed the surgical findings and the operative procedures in 400 cases of cholecystic disease on my service at the Mayo Clinic during the last four years from July 1, 1926 to June 1, 1930, including the cases on which some surgical procedure on the gall bladder was required, and excluding all cases of secondary operations on the ducts for stone, stricture, malignant obstruction and so forth. Common duct stones were associated with cholecystic disease in 32 cases, or 6.5 per cent. In 27 additional cases, undue dilatation of the common duct led to exploratory choledochotomy unproductive of stones, an incidence of nearly 12 per cent necessity and advisability of exploring the common duct. It is furthermore worthy of note that in 4 cases of cholecystitis without stones, common duct stones were present. In but I of these had there been a previous operation upon the gall bladder, and that a cholecystostomy. In other words, one or more common duct stones were present in 3 cases in the absence of stones in the gall bladder.

Judd and McIndoe have recently suggested a classification of cholecystic disease, differentiating only between, first, acute, and, second, chronic cholecystitis, with subheadings under the latter of (a) chronic infective bacterial cholecystic disease, (b) cholesterosis, and (c) clinical or functional cholecystic disease. Except for the latter clinical subdivision the classification is on

the basis of existing pathology within the gall bladder irrespective of the absence or presence of gallstones.

From a clinical viewpoint, in terms of indications for operation, I am of the opinion that the question of stones is extremely important. Without doubt, there are many instances of cholecystitis without stones that are as urgently surgical as those cases in which stones are associated, and in many cases the symptoms are characterized by true seizures simulating gallstone colic, with failure to find stones at operation. In other cases without stones, the grade of cholecystitis is often as great as in those cases with associated stones. However, I am reminded (Table 1) that the gall bladder in 25 per cent of the cases of cholecystitis without stones upon which I have operated during the past four years failed to show any evidence of pathology when removed, even though hepatitis of a variable degree existed in many, and in all there was sufficient clinical evidence of cholecystic disease to justify exploration and cholecystectomy. Many of these patients have had complete relief of all symptoms following cholecystectomy, but unfortunately this has not been true of all.

Through the mechanical presence of stones, a different pathology exists from what is usually encountered in cholecystitis without stones. In Table 1 it is noted that there was an acute or subacute cholecystitis in 40 per cent of the cases with stones, while an acute cholecystitis without stones is rarely encountered except as part of generalized sepsis.

The so-called "strawberry gall bladder," or cholesterosis, is a most gratifying finding on exploration of the gall bladder, for the results following cholecystectomy, even though no stones are associated, approach very closely those obtained in the cases of cholesterosis in which stones are present. Cholesterosis was present in 22 per cent (Table 1) of the cases of cholecystitis without stones. Its incidence was not particularly noted in the cases of cholecystitis with stones. Mentzer reported an incidence

of stones in about 50 per cent of the cases of cholesterosis. Sanders recently reported a 10 per cent incidence of cholesterosis in 500 cholecystectomies.

Table 1 Cholecystic disease—499 cases

Condition	Number	Number	Per Cent
Cholecystitis without stones			23.8
Cholecystitis 1-1	• • •	30	25.I
Cholecystitis 1	• • •	34	28.5
Cholecystitis 2		7	5.8
Cholecystitis 4		9	7.5
Papilloma		12	10.0
Cholesterosis		27	22.5
Cholecystitis with stones			76.2
Chronic chloccystitis		227	59.7
Subacute cholecystitis		119	31.3
Acute cholecystitis		34	9.0

Table II
OPERATION IN 499 CASES OF GALL-BLADDER DISEASE

		Num- ber		Per Cent
Cholecystitis without				
stones	119		2	1.6
Cholecystectomy		54	I	
Cholecystectomy and				
appendectomy		56	1	
Cholecystectomy and		,		
choledochostomy		4		
Cholecystectomy and				
exploratory choledo-				
chotomy		5		
Cholecystitis with stones	380		10	2.6
Cholecystectomy		176	2	1.1
Cholecystostomy	• • •	11	3	27.0
Cholecystectomy and	• • •	••	3	_,.0
appendectomy		143	3	2.1
Cholecystectomy and	• • •	143	Э	
		2=	2	- ,
choledochostomy	• • •	27	2	$7 \cdot 4$
Cholecystectomy and				
exploratory choledo-				
chotomy	• • •	22		
Cholecystostomy and				
choledochotomy	• • •	I		

So far as surgical procedures are concerned in the treatment of cholecystitis, there frequently are associated lesions not only in the biliary tract but chiefly in the appendix and stomach or duodenum. The appendix is often as urgently surgical as the gall bladder. However, experience

has shown that if more than one of the associated lesions, as the appendix or lesion of the stomach and duodenum, is taken care of simultaneously with the gall bladder and biliary tract, the risk of the multiple procedures rises abruptly. The cases of acute cholecystitis, which for

individual problèm. Personally, I prefer the insertion of a drain in most cases. Infection is certainly a factor in mortality following operations on the gall bladder and biliary tract (Table III).

Finally, as regards the selection of cases for surgical exploration, it may be stated

TABLE III
CAUSES OF DEATH FOLLOWING OPERATIONS ON GALL BLADDER AND BILIARY TRACT

Çase	Sex	Age	Condition	Operation	Days Post- operative	Clinical Cause	Findings
ı	F	25	Cholecystitis 1-1 without stones	Cholecystectomy	10	Peritonitis ileus	Peritonitis
2	F	58	Chr. cholecystitis without stones	Cholecystectomy Appendectomy	10	Peritonitis	Peritonitis
3	F	бо	Acute cholecystitis with stones	Cholecystectomy	3	Myocarditis	No exam.
4	M	62	Acute cholecystitis with stones	Cholecystectomy	6	Peritonitis	Peritonitis
5	M	61	Acute cholecystitis with stones	Cholecystostomy	3	Pneumonia	Acute pancreatitis Fat necrosis
6	M	33	Acute cholecystitis with stones	Cholecystostomy	3	Pneumonia	Hemorrhagic bronchopneumonia
7	F	41	Duod. ulcer Chol. with stones Subacute app.	Gastroenterostomy Cholecystectomy Appendectomy	. 5	Pneumonia	Aspiration pneumonia
8	F	51	Chr. cholecystitis with stones		17	Pulmonary embolism	Pulmonary embolism
9	F	60	Chr. chol. stones Com. duct stones Chol. duod. fist.	Cholecystectomy Choledochostomy Close duod. fist.	15	Duodenal fistula	Duodenal fistula fat necrosis
10	M	36	Chr. cholecystitis with stones		30 !	Phlebitis and thrombosis	Phlebitis of rt. Fem. & il. veins Gangrene rt. foot and leg
11	M	43	Subacute chol. with stones	Cholecystectomy Choledochotomy	12	Cholangitis	Cholangitis
12	F	56	Subacute chol. with stones Diabetis	Cholecystostomy	27	Pneumonia Diabetis	Embolic pneumonia nephritis

one reason or another must be operated upon during the acute stage, carry with them the greatest risk, particularly if cholecystectomy is undertaken. The question of cholecystectomy versus cholecystostomy in general is one no longer worthy of controversy, except in cases of acute cholecystitis and those with associated common duct disease and obstructive jaundice of long duration. The question of drainage following cholecystectomy is an

that the history is of primary importance, that cholecystography is a most important adjunct to clinical findings, and that surgical results are best when surgery is confined to those cases in which cholecystitis can be diagnosed with a good bit of clinical certainty and little speculation. Under these circumstances, exploration will yield a high percentage of definite gross cholecystitis with stones, in which the surgical results are most gratifying.

NEW INSTRUMENTS FOR LIVING SUTURES

TO FACILITATE THE USE OF LIVING TISSUES AND TO REDUCE SUTURE TRAUMA*

Chas. Murray Gratz, m.d.

NEW YORK

AS early as 1901 transplantation of living fibrous tissue for the repair of anatomical defects was used in experimental and clinical surgery. The early method, using patch transplants, was not universally satisfactory. The viability of the transplant depends on the formation of fibrous connective tissue between the transplanted and the host tissues. The lymphatic supply which nourishes the transplant is obtained through this newly formed tissue. When large transplants are used the nourishment to their central and more dependent portions often proves inadequate. Excessive mechanical stress also tends to displace this connective tissue, more particularly if the edges are inaccurately or insecurely attached.

Gallie and Le Mesurier¹ were the first to use living material in the form of a suture. The changed form of the transplant allowed a larger percentage of stress to be borne by the suture itself; it was no longer necessary to rely entirely on newly formed connective tissue. The realization of this advantage widened its field of usefulness.

Living sutures being of a soft and slippery nature are difficult to handle with ordinary surgical instruments. Since they are short and no autogeneous material should be sacrificed, it is poor technique to use the long overlap in threading that is permissible with ordinary suture material. Gallie improved the old type surgical needle by sufficiently enlarging the eye to accommodate it to the size of living sutures. The tendency of the needle to become unthreaded was prevented by overtying with catgut. Threading these needles even with the enlarged eye is often a difficult and tedious process. Suture trauma is increased by the tendency of the

¹ Gallie and Le Mesurier. The use of living suture in operative surgery. The Canad. M. A. J., 11: 504, 1921.

suture to bunch in the eye of the needle and also by the effect of the overtying suture.

Realizing that these factors hinder the



Fig. 1. New needle for living sutures.

wide use of living sutures, I endeavored to develop new instruments which would not only overcome these difficulties, but would be suitable for use in osseous as well as in fibrous tissues.

A curved cutting edge needle of rectangular cross section was devised with a special eye. The details of the new needle are clearly illustrated in the illustration (Fig. 1). The needle is tapered posteriorly and curved on the outer posterior side. The eye is formed as an elongated wedge with the thin end toward the heel of the needle and is wider on the outer than the inner side. The posterior half of the eye is finished with sloping teeth while the anterior portion remains smooth. This type of eye permits the insertion of the living material edgewise at the larger anterior end. When tension is applied to the suture

^{*} Presented at the Orthopedic Section, New York Academy of Medicine, May 15, 1931. From the Dept. of Orthopedic Surgery, Broad St., and Pan-American Hospital, N. Y. C.

it is drawn down to the thin end of the wedge. The sloping teeth tend to force the material farther and more securely into

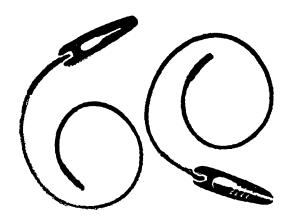


Fig. 2. New suture threader.

the eye. The specially designed eye permits the threading of the needle with a minimum of wasted suture, holds the suture with a maximum of firmness, and thus entirely eliminates the necessity of overtying. The absence of overtying reduces suture trauma, which is further minimized by the ease with which the suture may be threaded through the tissues. We were greatly pleased to find that the use of the finest materials and expert workmanship in making the new needle resulted in a much smaller instrument than the old type.

In using living sutures in bone surgery it has previously been necessary to tie the suture to a smaller one of catgut or silk which is in turn threaded through an ordinary needle. The fascial suture tends to fray as it is drawn through the bone and frequently pulls away from the guide suture. To facilitate the passage of the suture through bone Henderson placed cannulas through and beyond the drill holes to cover the rough edges of the bone. Bodkins have also been used. Many surgeons use large drill holes and push the suture through with a grooved director. All of these methods require larger drill holes with resultant weakening of the bone and an inaccurate apposition of the suture to its new environment. A second type of needle, really a suture threader, was

devised to simplify and improve this technique. The details of the new suture threader are here illustrated (Fig. 2). This is essentially the eye of the needle previously described made straight and very short with a flexible wire leader securely attached to the toe end. The flexible wire may be easily pushed through the drill holes; its flexibility permits the surgeon to insert the suture even if the holes are irregular or imperfectly aligned. After it has passed through the bone, the end may be readily grasped with a pair of forceps and the suture placed in position with much less dissection than if a straight needle had been used. This suture threader may also be used for prepared sutures.

Comment: 1. The new needles are threaded to the suture while the main body of the latter is intact and they remain in place until the suture has been firmly anchored in position. These needles may be threaded with ease by using a specially prepared mosquito clamp. The jaws are ground down so they can go through the eye of the needle grasping the tapered end of the suture on the outer side and pulling it through.

2. The special features of both these needles: the small size, the tapered eye, the tapered heel, and the groove on the posterior surface, not only render overtying unnecessary but in conjunction with the taper on the end of the suture allow the united portion to be approximately the same diameter as the main portion of the suture. This places the entire suture in close contact with either the fibrous or osseous structures by which it is surrounded. It is also possible in bone work to thread two sutures through one hole simultaneously. The accurate contact between the suture and the tunnel in the bone permits an adequate lymphatic supply, thus enhancing the viability of the suture. This is of the utmost importance, as a suture much smaller in diameter than the hole through which it is inserted has less likelihood of securing the adequate lymphatic supply on which its viability depends.

VASCULAR DISEASES OF THE EXTREMITIES

V. RAYNAUD'S DISEASE*

Amos Maverick Graves, M.D.

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AUGUSTE MAURICE RAYNAUD, in 1862, at the age of thirty presented for his doctor's degree a thesis entitled "Local Asphyxia and Symmetrical Gangrene of the Extremities."

Although the disease which he so masterfully described had been observed by Schrader, in 1629, and Hertius, in 1685, the following excerpt from his monograph shows that it had remained for him to establish the causative factor of this symmetrical mortification.

I propose to show that there exists a variety of dry gangrene affecting the extremities which is impossible to explain upon the basis of vascular obliteration; a variety characterized especially by a remarkable tendency to symmetry since it always affects similar portions of the body, the two upper extremities, the two lower extremities, or all four at the same time. In certain instances the nose and ears are also affected. I shall seek to prove that this kind of gangrene has as its cause a disturbance of the innervation of the capillary blood vessels.

CLINICAL PICTURE

Clinical characteristics of a typical case are concisely described by Cassirer as follows:

Somewhere in the peripheral portions of the body there occurs more or less severe pain. This is not confined to distinct nerve territory, but usually affects symmetrical parts. Attacks of vasomotor and trophic disturbances are part of the syndrome, to wit: (1) syncope, asphyxia, or local rubor, and (2) severe trophic disturbances, usually in the form of gangrene of the parts first affected with symptoms. The course is an intermittent one, for there may be completely free intervals; but in some instances, evidences of disturbed vasomotility may persist. The disease may consume itself in one attack or several attacks may occur in succession. Objectively, sensory disturbances are

usually absent, as well as paralysis, although other evidences of disturbed vasomotor innervation, aphasia, hemoglobinuria, and arthropathies may occur.

ETIOLOGY

A wide difference of opinion is found to exist among medical authors as to the predisposing and direct causes of Raynaud's disease. However, it is agreed that the symptomatology is dependent upon a vasomotor disturbance. Raynaud, Monro, Barker, Osler, Buerger, Barlow, and others have suggested a hereditary factor, but more recent studies seem to prove that Buchanan and Monahan are correct in definitely ruling out any inherited predisposition. The latter found a neurotic temperament to exist in only half the cases reviewed. Syphilis, malaria, typhoid fever, typhus fever, influenza, and other conditions which give rise to a toxemia have been thought to be etiologic factors, but now they are merely regarded as having occurred in association with the disease. Sexual excess and excitation were suggested as causes by Raynaud, but these, no doubt, should be listed as contributory factors, along with exposure, trauma, psychic exertion, sudden fright, and acute infections. That exposure to cold precipitates an attack can be demonstrated in the majority of cases. Monahan believes that in view of the sterility of the discharge from diseased tissues one must look for the fundamental cause in some constitutional abnormality or subnormality, which might produce a chemicophysiologic toxin.

INCIDENCE

Age. According to Raynaud, most of the cases occur between the ages of eighteen to thirty years. Monro gives the average

* Presented before the Surgical Faculty of Tulane University, New Orleans, March 17, 1030.

Previous articles on Vascular Diseases of the Extremities appeared as follows: I. Arteriosclerotic disease, vol. 12, p. 32; II. Erythromelalgia, vol. 12, p. 40; III. Thermic Gangrene, vol. 12, p. 324; IV, Thromboangiitis obliterans, vol. 12, p. 480.

age of onset as 28.9 years, and Morgan in his 93 cases found it to be 26.6 years. Cassirer collected 168 cases and found that there were 55 in which the disease occurred in the first and second decades of life as compared with 40 in the third decade. Subsequently, in studying 109 cases, he found the greatest age incidence from twenty-one to forty-years of age. Of 67 cases studied by Buchanan at the Mayo Clinic, 36 were in patients from twenty-one to forty years of age. That the disease may frequently occur in children is evidenced by the fact that Cassirer collected 22 cases occurring in patients less than five years of age. In the more recent literature there are numerous reports of its occurrence in infants and in the newly born. Not infrequently the disease is reported to have been observed in individuals of advanced years; but that these are cases of true Raynaud's disease is to be doubted except in those few in which the symptom-complex was characteristic. E. P. Henry reported a case in which the phenomena occurred in the ears, nose, and extremities in a woman seventy-seven years old.

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Women are more frequently affected. Raynaud found that 80 per cent of his cases were in women; 6.2 per cent of Monro's cases were females, and this sex predominated in 62.9 per cent of Cassirer's series and in 59.8 per cent of Buchanan's series. Adson and Brown believe that with improvement in diagnosis the incidence of true Raynaud's disease in the male will drop to less than 5 per cent of cases.

The racial and geographical distribution has been shown to be fairly widespread. Three cases have been reported in the negro by Lee.

That Raynaud's disease is rare has been shown. Monro reports that it occurs about once to every 3000 other affections and Buchanan found that it comprised less than 0.02 per cent of registrations at the Mayo Clinic. At the Johns Hopkins Hospital there were 19 cases in 23,000 admissions.

Buchanan states that he could not demonstrate that physical or nervous strain incident to any one type of occupation or social stratum was a cause of the condition.

MODES OF ONSET AND DURATION

Sixty out of Buchanan's 67 patients described a sudden onset with portions of the body turning white, blue or black. Five described a gradual onset consisting of tingling, numbness, clumsiness, or indescribable discomfort occurring at irregular intervals, followed at a later date by the color phenomena.

Raynaud described the onset of the disease as sudden and the duration as short. Other early observers gave the same conception; but with a more widespread knowledge of its symptomatology and better methods of diagnosis the chronic and insidious forms of the disease have been recognized and not infrequently reported.

Monahan reports a case in which prodromal symptoms lasted for nine months before the acute stage occurred to persist for four years before amputation was resorted to.

Many of the mild cases require exposure to cold to produce the characteristic symptoms. These may clear up and remain symptom-free, especially if winters are spent in tropical zones. However, most cases remain remittently active, although some may never advance to the moderate or severe forms.

Buchanan reported that 30 of his cases had had symptoms for more than five years and of these 7 had been affected for from fifteen to thirty years and 1 for fortythree years. Thus, it is evident that the duration is not always short.

That the disease may spontaneously subside cannot be doubted. Proof of this cannot readily be obtained, as recovered cases are usually lost before a conclusive period of observation is ended. Certainly many mild cases remain undiagnosed or unobserved simply because they subside or do not progress to the extent that the classical picture is evident.

Even cases of moderate severity may progress slowly and subside after several attacks which have produced small areas of gangrene.

Osler states that the severe cases are exceptional, although every large hospital is likely to have one that returns at intervals for amputations until the victim finally drifts into an almshouse.

SYMPTOMATOLOGY

Three characteristic phenomena of the disease are generally described. These are: (a) local syncope; (b) local asphyxia; (c) local or symmetrical trophic lesions or gangrene.

The term "local syncope" was used by Raynaud to signify the blanching of a part. It is manifested in the fingers, toes, cheeks, ears or nose and less frequently in other parts by a sudden death-like, demarcated pallor and a decrease in surface temperature of from 15 to 20°. This condition lasts from a few minutes to a few hours and may rarely result in gangrene. It usually recurs with or without periodicity and is likely to be precipitated by exposure to cold. Associated with it is a feeling of numbness, tingling or coldness. The attack may be terminated by a painful reaction. In only 3 of Monro's 176 cases local syncope existed alone, and Buchanan noted it alone in 15 per cent of his cases. It occurred either concomitantly or associated with local asphyxia in 10 per cent of Monro's and in 42 per cent of Buchanan's cases.

Boyer originated the term "local asphyxia," but it was Raynaud who applied it to that phenomena of the disease which usually follows, but may rarely precede syncope. As the term implies, there is a local anoxemia which causes the skin to appear bluish white, dusky blue, slate color, dark blue, violet gray or purple, or there may be redness with mottling of degrees of blueness. Surface temperature is decreased less than it is in syncope, and there is often a temporary swelling of the part or a cold

sweat may appear. If this phenomenon persists, the skin becomes black and mortified, or there may result desquamation of the epidermis. Occasionally an incomplete asphyxia may persist for years to produce a false edema as a result of undernutrition to the part. Local asphyxia is more prone to recurrences and is usually accompanied by more severe pain than is syncope. This phenomenon occurred alone in 16 per cent of Monro's cases and in 6 per cent of Buchanan's. When it occurs simultaneously with syncope, there is a play of colors with many shadings from cadaveric white to several tints of blue or bluish red, or the phalanges may be white while proximally there is a change to a bluish tint. Pressure over an affected part displaces the color which characteristically does not reappear for some time.

Following either syncope or asphyxia there may follow a period of hyperemia in which redness is marked and is accompanied by increased pulsations, increased warmth of the part, increased moisture, and a tingling sensation approaching that of pain.

With recurrence and persistence of the phenomena discussed gangrene of the peripheral parts eventually results. A bleb may form at the tip of the fingers and discharge a blackish or serosanguineous content. The resulting ulcer usually heals by cicatrization. Not infrequently a finger tip may merely become thickened and indurated and later desquamate. More commonly there occur sharply demarcated blackened, symmetrical areas which remain dry for variable periods of time before sloughing. These areas may be massive, causing the loss of a leg or forearm or even a whole extremity. Healing by granulation with the formation of a tapering cicatrix is characteristic. Although the gangrene is usually of the dry variety, it may at times be moist.

Pain in this disease is an important symptom as it almost constantly occurs though it may be absent in one attack and present in another. It may precede an 86

attack; but usually it coincides with asphyxia or syncope as a painful numbness followed by a sensation of burning and tingling. It is exaggerated by pressure or the occurrence of gangrene and may occasionally radiate to unaffected extremities.

Heat and cold sensations are not changed, but rarely is there analgesia or diminution in tactile sensation. In all phenomena the skin is likely to be covered with a clammy moisture.

Motor disturbances are not observed unless muscular atrophy occurs.

Bone changes were first observed by Cassirer. Characteristically, one or more or all the terminal phalanges may become atrophic or disappear without the formation of a sinus. Long bones may also become involved as manifested by a thinning of the cortex and an increase in the size of the marrow cavity in an occasional case.

Pulsations in the dorsalis pedis, posterior tibial, and radial arteries are commonly thought to be absent during the stage of syncope. This is incorrect as pulsations, though at times diminished, may be elicited in all stages of the disease.

Blood pressure determinations, pulse rates, and blood pictures were found to be within normal limits in all cases at the Mayo Clinic. Hemoglobinuria was not observed in any case, though it has been reported by many authors.

AREAS INVOLVED

Of the cases reported by Buchanan the lesions were bilateral and symmetrical in 56." per cent and asymmetrical in 43.3 per cent. Buerger states that symmetry is occasionally lacking and reports of isolated cases in the literature substantiate this. Not infrequently the nose, lips, and sternal regions are affected and very rarely multiple gangrenous areas occur anywhere on the trunk.

Monro found the upper extremities were affected in 43 per cent of cases, the lower extremities in 24 per cent, and both in 22 per cent. Buchanan found the lower extremities more frequently affected, but

he reports quite a diverse distribution in some cases. Nineteen patients had lesions all over the body, one on the side of the tongue, one in the pharynx, one on the left side of the face and one in which both forearms and lips sloughed and healed by

That this disease has an even more widespread anatomical distribution is believed by many. Raynaud himself noticed that there were coincident alterations in the retinal vessels with impairment of vision in 2 of his cases when the characteristic phenomena occurred in the extremities. Many cases with like symptoms have been reported, the most recent being those of Shinkle and Appelbaum. Weiss reported a remarkable case in which the left cervical sympathetic nerve was involved causing the left chest suddenly to become warm and red, the left eyeball to retract, hyperhidrosis, and contraction of the pupil. A recession of all manifestations except for slight retraction of the eyeball was complete within a week, but recurrences occurred until finally a condition similar to a partial atrophy of the soft parts of the left side of the face remained.

Hemoglobinuria in association with Raynaud's disease was not observed by Raynaud. Hutchinson in 1871 recorded the first case in which this symptom occurred and subsequently similar cases were recorded by Druitt, Wilks, Southey, Barlow, Dickinson, Abercrombie, Monro, Spencer, and many others.

Scleroderma and sclerodactylia not infrequently occur in association with the typical phenomena of Raynaud's disease and have been thought by some to be merely a complication of Raynaud's disease. Certainly at times when either is present, it is impossible to rule out Raynaud's disease.

Raynaud referred to fibrous ankylosis of the terminal phalangeal articulations and to thickening along the processes of the palmar fascia and showed how remarkably such thickening may subside following recovery from prolonged local asphyxia.

Southey reported a case in which there was an effusion in both knee joints.

Osler states that in a large number of mental disorders attacks of Raynaud's disease have been observed. Mania, epilepsy, amentia, melancholia, circular insanity, and progressive paralysis of the insane have been reported to occur in association with the disease.

Not a few cases exhibiting the characteristic phenomena have developed transient monoplegias, hemiplegias, aphasias, and even paraplegias. It seems reasonable to regard these attacks as due to vascular changes in the brain of the same character as those which occur in the peripheral vessels.

PATHOLOGY

The most frequent lesion observed in Raynaud's disease is the gangrene which is usually of the dry variety. It is sharply demarcated and remains so until the slough comes away. Infection rarely occurs and healing readily takes place by granulation. When a peripheral part is involved, there results a characteristic tapering cicatrix.

Bleb formations with resulting ulcerations may be observed or there may occur dry dystrophic processes in which a dark scab forms and subsequently becomes detached in a scale-like manner.

That the characteristic lesions are due either to constriction of the capillaries or to dilatation and stasis in them has long been assumed, but it was not until 1925 that Brown and others made observations with the capillary microscope which satisfied all doubts concerning the type of lesions.

Brown concluded from a study of 8 cases under various conditions and in different stages of the disease that in local syncope there is a constriction of all three vascular elements in the skin and that in local asphyxia there is a refilling of dilating capillary loops from segments of arterial or venous blood or both. In this latter stage there is apparently a loss of coordination between the capillaries and arterioles.

The arteries still remain contracted, except for an intermittent relaxation which allows small segments of arterial blood to enter the dilated capillary loops. The venules apparently undergo similar reactions since a reflux of blood takes place into the capillaries Dilatation of the capillaries precedes the cyanosis, and it is this change in caliber together with a loss of tone which causes stasis and a resulting increase in carbon dioxide content of the blood.

PROGNOSIS

Prognosis as to life of an affected part has been poor in the past and amputations have been frequently performed in order to alleviate pain. It seems reasonable to assume that for the most part only the more advanced or severe cases were observed, and consequently the older writers have given a gloomy outlook for patients affected with Raynaud's disease. With an increasing number of early cases being recognized and observed for years and with the advent of more satisfactory therapy, we are finding that an affected part may remain useful for many years in not a few cases.

DIAGNOSIS

The diagnosis of Raynaud's disease is made on the finding of a combination of the characteristic phenomena. The mere observance of ischmeic fingers hardly warrants a diagnosis; but the absence of single symptoms in a case which has been adequately studied and observed for a sufficiently long period should only rarely render the diagnosis uncertain.

Differentiation of Raynaud's disease from other vasomotor and trophic neuroses is occasionally difficult and may be impossible without prolonged observation.

Certain cases of scleroderma, especially those exhibiting sclerodactylia, manifest vasomotor symptoms and are believed by some to be caused by lesions of the sympathetic nervous system. Numerous cases are on record in which Raynaud's phenomena occurred coincidentally with,

preceded, or followed the development of the indurative and atrophic stages of scleroderma and sclerodactylia. Since in Raynaud's disease there may not infrequently develop induration and thickening of the skin and subcutaneous tissues, a differentiation from scleroderma may be impossible until the skin lesion spreads to other areas in which manifestations of a vasomotor disturbance are not evident. The absence of pain and paresthesia is of value in eliminating Raynaud's disease; but when pain and paresthesia are present, one should consider that the two diseases coexist until further observation proves otherwise.

Erythromelalgia should offer no difficulty in differential diagnosis. The attacks are precipitated by heat or dependency of the affected part. The redness, increased temperature, and pain disappear on elevation of the part and are alleviated by the application of cold, whereas in Raynaud's disease the attacks are likely to be initiated by exposure to cold, are not infrequently relieved by application of heat, and elevation of the part does not result in a lessening of the asphyxia.

The acroparesthesia of Schultze or Nothnagel resembles Raynaud's disease in that suddenly or gradually the fingers or even the hands and arms become cold, numb, white, and painful. Disturbances of tactile sense and a diminished sensibility for needle pricks, touch, temperature, and electrical irritants exist. Both hands are affected, though usually unequally. The differentiation from an early stage of Raynaud's disease is impossible unless Raynaud's second phenomenon of asphyxia occurs.

Acroasphyxia chronica manifests itself as a slowly developing cyanosis of the peripheral parts without paroxysms or attacks associated with sensory or trophic disturbances. In certain cases a hypertrophy of the soft parts develops, which resembles acromegaly. Although this condition differs from Raynaud's disease in its progressive course, absence of paroxysmal

attacks and development of hypertrophied peripheral parts, there are cases which seem to be clinical transitions to Raynaud's complex. Even in these, however, syncope does not occur and pain is insignificant.

The differentiation of Raynaud's disease from obliterative vascular disease is usually easy. In arteriosclerosis of the extremities the calcified vessels are palpable as cords and are found not to pulsate, whereas in Raynaud's disease pulsations are obtainable at all times. The paroxysmal nature of the attacks, the youthfulness of the patient, the absence of pain of intermittent claudication, and the more frequent involvement of the upper extremities are important differential points for Raynaud's disease.

Thromboangiitis obliterans with vasomotor symptoms is at times difficult to differentiate, especially since Buerger warned that in Raynaud's disease ischemia and rubor may be elicited. These, however, may be observed only during the paroxysms in Raynaud's disease, whereas they may be elicited at will in thromboangiitis obliterans. If this point is borne in mind, no difficulty should be encountered in arriving at a diagnosis. In certain cases of Buerger's disease the inexperienced may be misled by finding that the dorsalis pedis pulsation is still present. In these the thrombosis has not extended beyond the digits, and the rubor and ischemia are found to be more or less limited to the area of vascular obliteration. If other characteristic symptoms of thromboangiitis obliterans, such as pain of claudication, trophic lesions, and migrating phlebitis are not present, one may have to depend on the sex of the patient and the localization of the disease for differentiation.

TREATMENT

Therapy in Raynaud's disease aims only at a symptomatic cure. Mild cases which are more common probably do best without any treatment other than the institution of prophylactic measures. The wearing of warm loose gloves, soft woolen stockings,

and adequate clothing usually suffice to minimize the frequency of attacks. Removal to warm, even climates has proved beneficial in not a few cases. Attacks may be aborted or shortened by the application of heat. If these cases do not progress in two years, they probably never will; but should they become more severe, more energetic measures are indicated.

Repeated galvanic hand and foot baths of ten minutes' duration have seemed to help some few; but results equally as satisfactory may be expected from the production of hyperemia by Bier's method or by the use of an elaborate apparatus designed to produce a negative pressure about the affected part. Cushing advocated the application of a semi-elastic bandage just tight enough to constrict the venous return from the part. This may prove beneficial, but pain is intensified.

Amyl nitrite and nitroglycerin have quite naturally been given a trial by many, but there are no reports of either's ever having been of constant benefit.

Various endocrine gland extracts have been vaunted as of exceptional value, but like all other conservative measures they have fallen into disuse in uncomplicated Raynaud's disease.

Recently Brown and Adson have reported distinct benefit in some few cases from the production of a febrile reaction by the injection of non-specific proteins. A vasomotor paresis is thought to result from fever.

Certainly conservative treatment as outlined has only occasionally proved satisfactory. Those cases not destined to remain mild have progressed in spite of treatment and, because of this, more radical measures were sought, and these are now fast becoming standardized.

Small areas of gangrene should be allowed to demarcate and slough, as healing by cicatrix may be expected. Large gangrenous areas are best amputated to save time and free the patient of pain.

With the development of surgical procedures designed to interrupt innervation of the affected vessels, it became customary to refer to the surgeon all cases which showed trophic changes or gangrene. The results in these were at first inconstant, but encouraging enough to warrant further investigation. Various modifications were instituted clinically and experimentally, and out of fifteen or more years of untiring effort have come certain standardized surgical procedures on the sympathetic nervous system which promise such an excellent symptomatic cure that all but the mild unprogressive cases should be given the benefit of this newly developed therapy.

The evolution of surgery of the sympathetic system is an interesting chapter, too lengthy for a detailed review in this paper. In 1913 Leriche performed his first periarterial sympathectomy believing that he was dividing the motor nerves of the vessels. The result was gratifying and in subsequent procedures on well selected cases the symptomatic relief warranted his removing the adventitia from vessels in over 300 cases manifesting symptoms of various vasomotor disturbances. Other workers, because of faulty technique and improper selection of cases, did not obtain comparable results and the procedure became the subject of criticism. Leriche observed that his procedure produced bilateral vasodilatation and eventually concluded that he was not interrupting vasomotor fibers, but that he was altering vasomotor activity by dividing pressor or centripetal fibers. He reasoned that division of these fibers around one vessel stimulates "long distance" reflexes which result in a transitory modification of blood pressure and blood flow in all four extremities and that local hyperemia is of a more persistent nature because pressor influences are freed from distal intramural centers, which probably exist even though they have not been demonstrated anatomically. Regardless of how a periarterial sympathectomy produces its characteristic effects, it is probably worthy of trial in those who are poor risks for a ganglionectomy, because it is easy to execute and because there is

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clinical evidence to indicate that a symptomatic cure may occasionally be expected. The hyperemia obtained by this procedure may last for only one or two weeks, but the symptomatic relief not infrequently persists. Leriche in 1928 stated that periarterial sympathectomy produces less marked and less persistent local hyperemia than does sympathectomy upon the trunk. This latter procedure apparently has not produced the unfavorable complications that were predicted for it, and therefore its use in even moderately severe cases is justified.

Adson and Brown, quick to recognize the incompleteness of effects from the Leriche operation, sought more satisfactory results from operations on the sympathetic trunk. In 1924, Royle, after sympathetic ramisectomy for spastic paralysis, observed a capillary dilatation of the leg on the operated side. Soon after this, Adson and Brown began using a modification of this procedure for Raynaud's disease and found that pain was relieved, abnormal color reactions disappeared, the feet and legs presented a pinkish color, were drier and sustained an average increase in temperature of 12°c. They believe that the distribution of the gray rami from the lumbar ganglia is not constant, and, therefore, instead of doing a simple ramisectomy as urged by Leriche, they resect the second, third, and fourth lumbar ganglia with the intervening trunk bilaterally, thus making sure that interruption of all efferent impulses below the second lumbar ganglion is complete. Patients so operated upon have remained symptomatically cured for as long as five years and promise to remain so permanently. Davis and Kanavel performed a similar ganglionectomy on one side in a case of erythromelalgia and obtained definite improvement. Thus, for the lower extremities one has a procedure which gives complete and satisfactory results.

But Raynaud's disease more frequently attacks the upper extremities and cervical sympathectomies as done by Adson and Brown, Fulton, Diez, Royle, and Davis and Kanavel have given only incomplete re-

sults. These workers excised the stellate ganglion in all cases and in some all of the cervical ganglia were removed. Davis and Kanavel, after observing their result, concluded that removal of the stellate ganglion alone would suffice. Recognizing that results obtained in the upper extremities were not as satisfactory as those observed in the lower extremities. Adson and Brown concluded that all efferent vasoconstrictor impulses to the vessels of the upper extremity were not being interrupted. This was verified in 1927 by Kuntz, who showed that the second thoracic ganglion contributes gray fibers to the first thoracic spinal nerve, as well as to the second thoracic spinal nerve, and this, in turn, often contributes to the lower trunk of the brachial plexus. Subsequently, Adson and Brown through a posterior approach succeeded in excising the second thoracic ganglion along with the stellate ganglion and the intervening trunk on the right side of a patient with Raynaud's disease. Following this the right hand became warm and dryness of the skin was noted over the entire right arm, axilla, right side of the face, and the right anterior surface of the chest down to the sixth interspace and posteriorly down to the fifth dorsal vertebra. An incomplete Horner's syndrome was present, but it later almost entirely disappeared. At a later date the left side was operated upon with similar success, except that the Horner's syndrome on this side remained. Subsequently other patients subjected to the same procedure were similarly benefited.

Adson now advocates resection of the last cervical together with the first and second dorsal ganglia. This change was instituted, because the other procedure did not completely interrupt sympathetic fibers as evidenced by the incompleteness of the Horner's syndrome obtained.

It seems reasonable to expect multiple symptomatic cures in patients manifesting Raynaud's phenomena in all four extremities if these complete procedures are properly executed.

[For References see p. 128.]

PARTIAL RESECTION FOR UNILATERAL REDUPLICATION OF PELVIS AND URETER*

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TN a recent article published in the Journal of the American Medical Association upon conservative surgery on the kidney, Waltman Walters drew attention to the fact that 3 patients having heminephrectomy for reduplication of the ureters were successfully operated upon by William Mayo and reported by Braasch in 1912. Young and Davis in 1917 have been quoted as saying that these 3 cases were probably the first successful ones in the United States. At that time they were able to find in the literature only 26 cases in which heminephrectomy had been done for duplication of the renal pelvis, and added I of their own bringing the total to 27.

However, resections for various reasons were done much earlier than this. To Pawlik is given credit for first attempting partial nephrectomy in double kidneys in 1896; yet Czerny as early as 1887 reported a case of resection for tumor of the lower pole. Tuffer in 1891 operated upon a patient for a localized cyst, and Keetly resected part of a traumatized kidney.

At the close of the 19th century conservatism was quite popular but short-lived. For, Kuster in reviewing the literature of the earlier days, found 30 cases of partial resection, out of which 18 patients improved, 7 did not, and 5 died. Apparently the results following partial resection did not find favor with the surgeons of that day, as very little further is to be found in the literature concerning the subject.

The mortality in these early cases was 16 per cent, but as Judd pointed out this was comparatively low in the early period of renal surgery, considering that nephrectomies were being then performed with a mortality of from 25 per cent to 35 per cent.

With the introduction of the 20th century conservatism was again overshadowed by radical nephrectomies, but only again to be replaced in the last ten years of this century by what may be summed up in the words of Hinman, who says, "Conservation of renal tissue is the objective of modern renal surgery."

Judd in 1925 reported a series of 8 operations performed for various reasons, 2 of which were for reduplication of the pelvis. This was followed by a report in the same year by William Honan for calculous pyonephrosis. From then on we find the literature much richer in this type of work with case reports by such men as Young, Quinby, Eisendrath and Phifer, Papin, Beer, Hymen, Keyes Furniss, Von Lichtenberg, McCarthy, Lazarus, Bugbee, Hunt, Walters, Rathbun, Lower and Belcher, De Vries, and Campbell who reported a series of 5 cases before the Genito-Urinary Section in the New York Academy of Medicine two years ago.

However, in spite of all this work, only 222 cases of partial nephrectomies performed for all causes, including cysts, localized tumors, trauma, tuberculosis, horseshoe kidneys, ecchinococcus cysts, reduplications and associated calculous pyonephrosis, have been reported up to 1928.

The case we present is of that of a young man forty-two years of age, first seen by me last July in a severe attack of pain in the left kidney region, associated with scanty urination and simulated to all extent and purposes a typical renal colic. A urinalysis at the time showed only an occasional red blood cell and pus cell. With the exception of a typical Murphy sign over the left lumbar region, a physical examination as well as a plain x-ray

^{*} From The Urological Service, Flower Hospital, N. Y. C. Read before the Section of Genito-Urinary Surgery,
. New York Academy of Medicine, December 17, 1930.

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of the genitourinary tract was normal. His previous history is one of interest and dates back seven years, when he first experienced a severe excruciating pain in the left kidney region, localized through this area but persistent in nature and increasing in severity. He was then removed to Bellevue Hospital where he remained for three weeks feeling much improved upon being discharged. Since then these attacks have been growing more frequent, so that he would lose a great amount of time from his work and was thought to be a malingerer.

Cystoscopic examination at this time did not reveal any pathology, and had it not been for a pyeloureterogram a diagnosis of this condition could readily have been overlooked. The split urines from the right and left kidneys were quite negative with the exception of a few red blood cells and pus cells from the left side. Both kidneys functioned well and the return of the intravenous indigo dye was five minutes from both kidneys and in very good concentration. Cultures and smears were negative for organisms. The urea content was normal from both sides.

Pyeloureterogram showed a definite reduplication of the pelves and ureters, which met just above the bladder and entered this organ as one ureter. It seemed as if the ureter from the upper segment was crossing the lower ureter at its pelvouretero junction, and in this manner causing temporary attacks of hydronephrosis.

Considering all the facts of this case, the predominant factors for surgical intervention were first pain, excruciating in character, more severe with each attack, seven years in duration, which now had become quite frequent. Second, beginning hydronephrosis of the lower segment, and third, the economic factor in loss of time, for work was now becoming almost impossible.

Reduplication per se has been estimated to have an incidence from post-mortem examinations anywhere from 3 to 4 per cent, and most cases are of themselves only of academic interest, found during the routine urological examination and now more than ever with the advent of intravenous urography.

Mertz had found pathological changes occurring in about 28 per cent of 300 autopsies of patients who have died from other causes. Braasch and Scholl in their study of 144 cases found 54 or 3712 per cent with pathological changes, and for this reason, although no true pathology could be found at the time of examination, yet they thought these anomalies gave greater cause for pathological changes than in the normal kidney. For this reason, and for symptoms mentioned before, partial resection of the kidney had been thought of, but since the degree of function or integrity of each segment was not known, an intravenous injection of uroselectan was done. This showed a normal return of the dye from both segments as well as from the opposite kidney in the first x-ray taken twenty minutes after injection.

In spite of all possible data, Bugbee and Eisendrath pointed out that it may be necessary for the surgeon to make his decision at the table as to whether a conservative operation or a nephrectomy should be done, which, as they pointed out, depended upon the blood supply to the various segments, the degree of function of each segment and the extent of perirenal and pelvic adhesions.

Eisendrath pointed out that those cases where the pelvis is completely divided the parts usually have a separate blood supply, the arteries usually arising from the aorta, and the veins extending to the vena cava. However, the diseased segment which is usually the upper may receive only a small branch from the aorta, or from the main renal artery, the main branch of which enters the larger segment and furnishes sufficient blood to permit resection. He showed that the blood supply in 35 cases of double kidney, 15 of these had one artery supplying both segments, and in 15 there was an artery for each segment, and in 5 three arteries supplied both segments.

In spite of all this explanation, the patient refused operation and left the hospital temporarily feeling well, only to return in a short time begging for any measure that would give him permanent relief. Blood examination, blood counts, blood pressure, Wassermann test, were all found to be normal. A two-hour

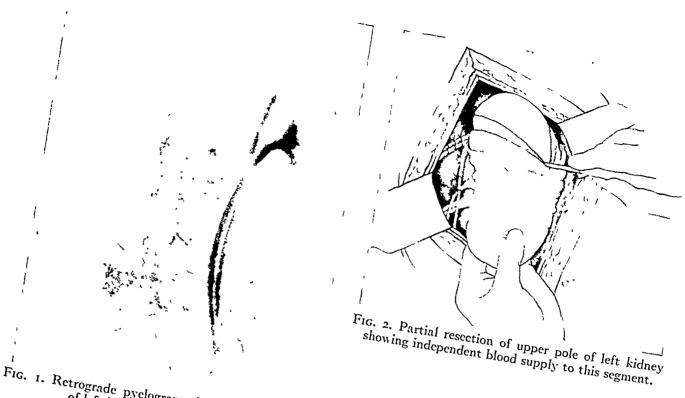
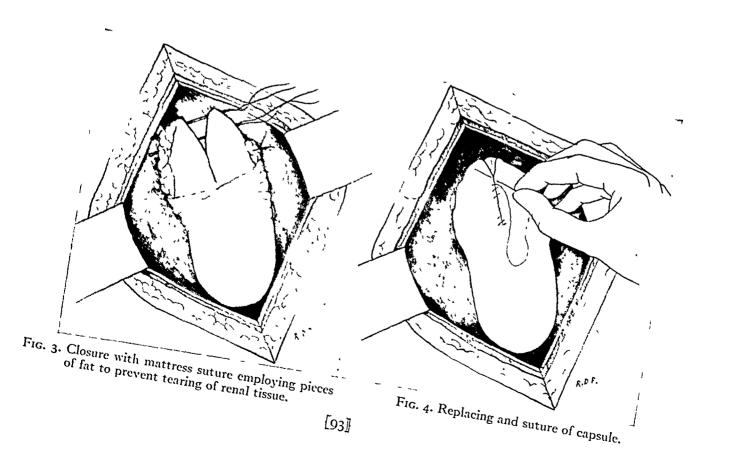


Fig. 1. Retrograde pyelogram showing reduplication of left kidney pelvis and ureter.



phenolsulphonethalein examination showed a return of 25 in the first hour, in the second hour, 12, and combined showed 37.



Fig. 5. Postoperative cystoscopy showing reduplicated ureter and single pelvis.

Operation: Operation was performed on August 16, 1930. Incision was made from the left costovertebral angle downwards and almost parallel with the iliac crest just a little above the anterior superior spine. The muscles divided and the renal mass was exposed. The kidney was placed high up under the arch of the diaphragm but with manipulation was brought into the field. The furrow which would indicate the piont of separation of the two renal pelves was absent. Examination of the pelvis showed it to have two distinct ureters; the upper seemed to be under great tension crossing the lower ureter at the pelvouretero junction, and acted probably like an aberrant vessel, where a great amount of pelvic inflammation and connective tissue adhesions were found. The individual parts, including the blood vessels, were not as easily demonstrated as one would believe from the drawing. However, two distinct blood supplies were found, which apparently were independent and had their origin from the aorta and the vem extending

to the vena cava. This fortunately made it easier to control hemorrhage in doing a resection of the upper pole.

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Before an attempt to ligate the vessels supplying this segment, as well as to ligate the ureter, a decapsulation of the upper pole was performed. We did this because it has been found in a recent experimental study by Herbst and Polkey on dogs that partially nephrectomized kidneys where a decapsulation of that portion of the kidney was first done, and later on employed in closing over, gave much better results than where the v-shaped incision was done without stripping the capsule.

The vessels supplying the upper segment were then tied, as well as the ureter, as demonstrated in the accompanying drawing, and a blanching of the upper pole of the kidney could easily be visualized. This was recently demonstrated by Von Lichtenberg in Dr. McCarthy's clinic. The wedge of the upper segment was then easily removed, care being taken not to enter the pelvis of the lower segment. The control of hemorrhage by mattress sutures which we employed in tying them over small pieces of fat taken from the neighborhood has recently been subjected to criticism by Herbst and Polkey, who claim that of all the methods employed the simple through and through suture as advised by Tuffier after the stripped capsule had been replaced gave the necessary requirements as to control of hemorrhage, as well as not producing a destructive atrophy to the renal parenchyma and therefore a corresponding reduction in the functional qualities of the remaining kidney tissue. However, the capsule was then brought together by continuous suture.

The kidney was then dropped back into the wound, two rubber drains inserted, and the wound closed in the usual fashion. But not until we came to a check-up did we realize that a simple step which could have easily been done and will not I hope cause the patient to suffer another operation, was the lack of removing the cut ureter as far down as the incision would permit, for it has been pointed out that infection of this blind duet may cause as much trouble as the original condition. However, to date no such complication has taken place.

The patient made an uneventful recovery, and was discharged from the hospital three weeks after admission with a slight sinus at

the point of drainage, which has since closed. It is now four months since his operative interference, and for the first time in the past seven years he has been free of any discomforting pain in the kidney area. He has since put on about 15 lb. in weight and returned to work.

A recent check-up to demonstrate the viability of the remaining segment showed a urea content of this kidney now to be 1.4 per cent as contrasted with 1.8 per cent prior to operation. The opposite normal kidney has increased its urea content in the

same proportion as the operative kidney has lost. This would fit in with Hinman's work on counterbalance, but we doubt whether enough tissue has been removed to stimulate compensatory hypertrophy. An intravenous indigo dve, however, showed normal return from both sides in about the same concentration. It will be interesting in about a year to make comparative studies as to the percentage of pthalein output of both sides, and compare results of those of other authors.

[For Discussion, see p. 102.]

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(References Continued on p. 111.)

RENAL AND URETERAL CALCULI*

SOME PRESENT DAY SURGICAL PROBLEMS

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THE problem of dealing with urinary lithiasis is an ever fruitful subject for discussion. Whether it be the ureteral calculus which tarries too long in its passage through the ureteral channel or massive coral calculi involving both kidneys, the individual case brings its own difficulties which require solution.

That no eminently satisfactory method of dealing with small ureteral stones has vet been found is evidenced by the numerous devices which have been invented for the purpose of dislodging retarded stones and speedily bringing them through a ureter almost too small for their passage. To accomplish this, ureter catheter manipulation is of such common practice that it may be regarded as universal and it is credited with an enormous number of successes. Yet, when we take into account the fact that the majority of small stones will pass spontaneously, the actual value of the procedure must be discounted considerably.

The failures of the method furnish the incentive to look for more reliable means and an array of dilators, crushing forceps, screws, slings, bulbs and the like is the answer.

The suggestion made a few years ago of passing several ureteral bougies past a lodged ureteral calculus and withdrawing all at once in the hope that these bougies had disposed themselves along different sides of the stone and would thus hold it within their grasp and deliver it into the bladder has much to recommend it. By this method the ureter has on two occasions delivered troublesome calculi.

It has an advantage which the more complicated devices do not possess, namely that, should the stone become so tightly wedged that it cannot be brought out with-

out danger of injury to the ureter, the bougies may be removed one at a time.

That the use of the simple bulbous bougie is not without its dangers is shown by the writer's experience in dilating a ureteral stricture behind which a stone was lodged. The bougie was passed through the stricture and beyond the stone but upon the attempt to withdraw the bougie the stone was caught under its shoulder and could not be disengaged. Removal of the calculus through an iliac incision liberated the entrapped bougie.

The length of time in which one is justified in using intraureteral measures naturally varies in wide limits in different cases. The comparative size of the calculus and that of the ureter as shown by urogram, the shape of the calculus, the history of previous passage of urinary calculi, the impairment of renal function, evidences of serious infection during attacks of ureteral occlusion, and the general physical condition of the patient are the factors for consideration in the individual case in deciding upon operation or persistence in intraureteral manipulation. Calculi of unusual size lodged in the lower ureter near the bladder almost always require operation, yet there are occasional exceptions, which the following case will illustrate.

Case 1. A man forty-two years old whose stone-bearing history covered a period of twenty-five years, showed by x-ray examination two large calculi in the lower right ureter. The shadows were about equal in size and measured approximately 7 by 15 mm. The ureteral orifice was enlarged with cystoscopic scissors, and rectal massage given in an effort to dislodge the calculi. Shortly afterwards one of the stones passed into the bladder and was removed by litholapaxy. In a few days the second stone was passed into the bladder and it also was crushed and removed.

Enlargement of the ureteral orifice for the release of a stone engaged in the intramural portion is more satisfactorily accomplished by surgical diathermy than by incision as hemorrhage is thus avoided and the sear is less.

The value of cystoscopic methods in aiding passage of ureteral calculi is expressed in a recent report by Squires¹ of the Crowell Clinic. Of a total of 606 cases the calculi were recovered by cystoscopic methods in 528 or 87.13 per cent.

Caution must be observed in dealing with a migrating stone, and especially should one not delay surgical removal when there is evidence of advanced pathology in the kidney.

The following case illustrates some of the difficulties encountered in dealing with a migratory calculus and emphasizes the danger of intraureteral manipulations in the presence of stones of this character.

Case II. In a man of fifty-six years, suffering with renal colic, the x-ray showed a stone 0.5 cm. in diameter opposite the right transverse process of the fourth lumbar vertebra. A ureter catheter was obstructed at this point. Albolene was injected into the ureter and the attack gradually subsided. Ten days later x-ray showed the calculus in the kidney pelvis. Shortly afterwards he had another attack of colic with fever and reduced urinary output. He developed hiccups. x-ray now showed the stone to be about 4 cm. from the bladder. The ureter was catheterized, lavage given and the catheter fixed. Hiccups ceased and the general condition improved. Ureteral dilatations were performed at intervals of seven to ten days and drainage maintained for brief periods afterwards by indwelling ureteral catheter. X-ray showed the stone at one time in the ureter and at another in the kidney pelvis. After the fourth treatment he developed fever, rapid heart, rigid abdomen and failed rapidly and died three days later. Autopsy disclosed acute peritonitis centralized about the right kidney. The kidney contained multiple abscesses. No injury could be demonstrated in the ureter or renal pelvis. The ureter was dilated except near the bladder, and contained a small stone which was freely movable throughout the length of the ureter.

When a calculus obstructs one ureter and anuria occurs, if a single manipulation fails to establish drainage immediate surgical intervention is usually indicated. Exceptionally secretion of urine may be reestablished by stimulating measures and operation delayed for a more favorable condition of the patient. In one such case, the anuria being of fifty-two hours' duration, copious secretion of urine followed stimulating measures and removal of the obstructing calculus was delayed until the fifth week after the anuria occurred.

In the presence of bilateral stones, although intraureteral measures may result in some downward progress of the stone, sudden complete occlusion of both ureters may occur, producing a similar problem and surgical removal of the obstruction becomes imperative.

When operation for the removal of a ureteral stone is undertaken, damage to the kidney may be so advanced that nephrectomy is indicated, yet the impairment of function of the other kidney may make the procedure inadvisable. In certain instances the repair is remarkable in what seemed a hopelessly diseased kidney, after drainage has been reestablished through removal of the stone.

Renal stones requiring operative removal are not sufficiently similar to permit the adoption of a routine procedure. Most urologists prefer pyelotomy to nephrotomy, especially in cases of small or medium sized stones in the pelvis of the kidney or accessible calices. Stones of considerable size, even those having branches into the calices, may be removed by enlarged pyelotomy² without incurring the dangers which commonly attend nephrotomy. By corrosion models Deming³ has shown that enlargement of the pyelotomy incision may be extended straight into the kidney or to the lower pole without impairment of the circulation of the kidney if the retropelvic vessels are conserved.

It is not assumed that all renal calculi are amenable to operation by this method. For the coral-like stone, for the calculus exclusively renal, or the multiple disseminated stones deep in the calices, it is evident that this operation will not be sufficient but may need to be augmented by small nephrotomy incisions to liberate small stones or fragments lodged in the calices. For the stones of the pelvis that are prolonged into the kidney, enlarged pyelotomy will often suffice for their delivery. Naturally there should be a radiogram that demonstrates clearly the characteristics of the stone and which leaves no doubt as to its shape and its direction, but shows equally well the absence of fragments situated a little distance away or in totally different positions.

In cases of bilateral renal calculi of the branched or staghorn or giant type, there is often no pain, the patient suffering from

septic absorption.

In deciding on operation, one will consider whether the removal of the calculi involves greater destruction of kidney tissue than will result from the presence of the calculi or whether probable improvement following removal of the stones justifies the risk. A stone free in the pelvis, causing intermittent obstruction, may require first consideration. The development of acute infection may demand immediate action.

Generally the kidney with the better function should be operated on first to conserve to a maximum its function before operating upon its fellow. This opinion is best applied in the case where one kidney is almost completely destroyed and the other has fair, or good function. There are many exceptions to the rule.

Multiple calculi in different parts of the urinary tract may be present in addition to bilateral renal stones, i.e., in the ureters, the bladder and the urethra. Unless there are contraindications those stones in the lowermost position in the urinary tract should be removed first. No rule can be laid down as each case must be handled according to its individual peculiarities. Likewise the time of operation calls for the exercise of good judgment. Postpone-

ment in one case may give an opportunity for improvement, whereas delay may result in a hopeless state that might have been avoided by an early operation. It is important not to undertake too much at one operation.

Many of these patients suffer from the presence of incurable infection of the urinary tract and the most one can hope for is to minimize the infection and relieve pain. Although many of them are incurable they may derive great benefit from a well planned and carefully executed program of operation and gain several years of comparative comfort.

Several lesions may exist in a single kidney giving rise to similar symptoms. We should not be content with a selfevident diagnosis as renal stone, and overlook the presence of coexisting pathology.

In a survey of 1817 cases of renal tuberculosis at the Mayo Clinic Crenshaw⁴ found renal calculus associated with renal tuberculosis in 1.8 per cent of the cases. This datum may be taken as indicative of the relative occurrence of such combined pathology. Four cases of renal stone associated with renal tuberculosis have been observed among our cases. In 1 case a shadow in the upper pole was mistaken for calcification in reading the x-ray. After nephrectomy the specimen was found to be that of a tuberculous double kidney, the upper pelvis of which contained a calculus.

Case III. A particularly interesting case was that of a woman (Mrs. G.) forty-eight years of age, who, in a period of twenty-two years, had recurrent attacks of hematuria, numerous attacks of renal colic, followed by the passage of calculi, nephrotomy for kidney stone, and spontaneous rupture of a loin abscess, the sinus persisting many months. She was referred to us by Dr. W. N. Taylor of Columbus, Ohio, who had diagnosed left calculous pyonephrosis and exophthalmic goiter. The right kidney was normal. Through a lumbar incision a large pyonephrotic kidney, containing several large calculi, was removed with great difficulty, a capsular enucleation being necessary. The pathologist's report showed, in addition to the general destruction,

due to pyonephrotic changes, several areas in the remnant of renal parenchyma which contained giant cells and tubercles.

Operation upon a solitary kidney is attended by considerable apprehension by both the surgeon and the patient. Keyes³ has made the observation that the removal of uncomplicated stone from the pelvis of the solitary kidney in 6 cases shows that these patients stand operation almost as well as patients with two kidneys. Walters⁶ of the Mayo Clinic, found record of 45 cases of solitary kidney in which operation upon the kidney or ureter had been done for the removal of calculi. The mortality was 13.3 per cent.

Four of the writer's cases of calculus in solitary kidney have been treated. One of them was in a young physican who had lost one kidney by emergency nephrectomy soon after a calculus had been removed by nephrotomy. A year or two later he had anuria due to a calculous obstruction of the ureter of his remaining kidney. We succeeded in passing a catheter beyond the calculus and relieved the retention. Shortly afterwards the stone was passed.

In another case of a young man who had lost a kidney by operation for calculous pyonephrosis a stone formed in the remaining kidney. This stone was of the migrating type. After several efforts to cause it to pass by catheter manipulation, ureter dilatations, etc., operation was undertaken after a catheter had been passed to make sure the stone would remain in the kidney during operation. Through a pyelotomy incision attempts to find the stone failed and much effort was expended by way of irrigations to flush it out but did not succeed. Finally, in acknowledgment of failure, a drainage tube was inserted through the cortex and the kidney replaced. The prolonged operation added too much to his already overtaxed kidney and he died, uremic, four or five days later.

The use of the fluoroscope to locate a stone during operation is not always feasible, as was demonstrated in this case in which a short renal pedicle in a fat subject made the procedure entirely unsuccessful.

CASE IV. Mrs. M, a woman of thirty-four, was one of the cases of nephrectomy for calculous disease associated with tuberculosis. Prior to removal of the left kidney in May, 1929, a pyelogram of the right showed it to be normal. Six months later the x-ray showed the right kidney filled with stone. The film was an exact duplicate of the previous pyelogram. In February, 1930, she was again admitted to the hospital with anuria of forty-eight hours' duration. Efforts to catheterize the right ureter failed. Emergency nephrotomy was performed, numerous stones removed and nephrostomy drainage established. In November, 1930, x-ray showed recurrence of calculi. The sinus was dilated and several masses of calcareous material were removed. Future management of the case will be guided by whatever emergency arises. The outlook is manifestly far from being hopeful.

Cases in which urinary calculi cannot be demonstrated by x-ray are diminishing in number as x-ray equipment is improved and as our methods of applying x-ray are modified to intensify shadows or to demonstrate filling defects. Very small calculi frequently do not give a shadow by x-ray and this group furnishes most of the 10 or 15 per cent of cases of renal colic in which the x-ray examination is negative, though stone is diagnosed by wax tipped catheter. In such a case where the stone does not pass promptly, more intensive application of x-ray study will usually show either a shadow or a rarefied area in the urogram. Larger stones occasionally are not demonstrated in the x-ray.

Two cases of cystinuria with calculi have come under our observation, both in boys, one eighteen and the other sixteen years of age.

In the first no shadows were obtained by x-ray though several calculi passed spontaneously and an accumulation of small stones in the lower left ureter required operative removal. During convalescence from the operation colic occurred on the opposite side accompanied by anuria. Ureterolithotomy was again necessary for

removal of a stone lodged in the right lower ureter.

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In the second case (C. F.) the stones were also bilateral. From the lower left ureter a calculus was removed by ureterolithotomy and at a later operation the right kidney, a large calculous pyonephrosis was removed. This kidney had been operated upon seven years before for stone. These typical slightly translucent cystine stones gave good shadows to x-ray.

Calcified lymph glands in the region of the kidney are occasionally the cause of confusion in diagnosis where stone is

suspected.

Several cases of renal calculus are recalled in which gallstones also were present but the position of the gallstone shadows in the x-ray gave no cause for doubt as to their identity.

Rapid formation of stone in the septic bladder is a matter of common observation, and the same is also true within the kidney. Marked interference with drainage accompanied by infection would seem to provide the condition most likely to give rise to rapid accumulation of calcareous material.

The case previously mentioned of the woman who had lost one kidney affected with calculous disease and tuberculosis, had what seemed to be a normal condition of the opposite kidney at the time the nephrectomy was done, yet within six months the remaining kidney was filled with stones.

Case v. Mr. S. Large branched stones were removed from both kidneys by enlarged pyelotomy. When first observed the concretions were small, not larger than a bean in one kidney, and in the other a small speck of calcified material. On one side the ureter was strictured near the ureteropelvic juncture. In this kidney the stone grew more rapidly, filling the pelvis in nine months; the other kidney was filled in twelve months. Removal of the stones and dilatation of the stricture of the right ureter, and the clearing up of foci of infection in teeth and tonsils have cured his urinary infection. During the period of a year we observed rapid formation of bilateral kidney stones, notwithstanding that the patient was

under close observation and regulation as to habits, diet, medication, etc.

Hunner's assertion that renal calculi are secondary to ureteral stricture finds support in the condition of this man's right kidney, but it cannot be said to be true of the left kidney where stone formation was equally rapid.

Braasch⁷ has suggested that to the various types of urinary calculi described in the literature should be added a form of pseudolithiasis which he calls hysterical lithiasis. This unusual manifestation of an abnormal psychological process is shown by symptoms simulating those of acute renal colic. In order to complete the deception the patient will produce a stone shortly after the colic, which, to the casual obser ver, may be mistaken for urinary calculus.

One of our cases, a young woman (Miss D.) described her attack of colic in all of its harrowing details and produced the result of her travail, which she had fished from the chamber. It proved to be a fragment of a parched grain of popcorn.

Case vi. Mr. G.'s case, thirty-nine years of age, who came to us June 21, 1927, was more difficult of solution. He gave a history of attacks of lumbar pain somewhat resembling renal colic and stated that he had passed 11 stones, 3 in one month. For ten weeks no stones had passed but there were evidences of one in the bladder which seemed to come down into the urethra and remain there. His physician said that he had displaced it into the bladder by instrumentation but was unable to get the urethra sufficiently open for the stone to pass. Upon exploration of the urethra a stone was detected in the bulbomembranous portion. Through an endoscope the stone was caught and extricated with urethral forceps. He was urged to go to the hospital for complete urological examination upon the ground that the lumbar pain which had preceded the passage of each stone suggested the origin of the stones as being renal and that the renal side of the diagnosis should be carefully worked out. He decided to return home. His physician reported by letter that he had extracted two more stones, one on June 27 and the other July 2. On August 2, 1927, the doctor wrote, "That

man still passes stones and number 21 is now in the deep urethra and I am not able to get it out. Eight have passed since he was at your office. But there are no indications that they pass from kidney to bladder—just through the urethra." He entered the hospital on the afternoon of October 18, 1927 for urological examination. The usual blood count, urinalysis, and kidney function tests were made. The following forenoon he left the hospital without permission, but before going he told one of the doctors that in the morning he felt the stone drop into his bladder. He produced a stone but its appearance caused great doubt as to its having originated in his urinary passages. He had no colic while in the hospital and received no morphine.

On March 12, 1929, he reentered the hospital on account of morphinism. The pulse and temperature, blood pressure, blood count, phenolsulphonthalein and urinalysis were all within normal limits.

After several days' observation it was decided his condition had improved sufficiently to proceed with his urological examination. He seemed to sense the significance of certain preparations and quietly slipped out of the hospital. We have not seen him since.

Case vii. A middle-aged woman who had previously been operated upon for renal calculus, came to the Indianapolis City Hospital periodically for removal of bladder stones. Some were small and could be removed with a stone evacuator without being crushed while others had to be crushed. On one occasion cystoscopic examination showed what appeared to be a flat, dirty white stone lying on the floor of the bladder. Upon prodding it with a ureteral catheter deep indentations were made. The whole mass was pumped out with the stone evacuator, and the material was sent to the chemist for examination. The chemist reported the material to be composed almost entirely of calcium sulphate.

The nurse was instructed to observe if she had visitors and what was brought to her. Within a few days her little daughter brought a paper sack containing white powder which the patient said was tooth powder. It proved to be plaster-of-Paris. Being thoroughly frightened over the exposure and the fear of prosecution by the insurance company which had paid weekly benefits for a long time, she told us how the deception was carried out. At first she

used a catheter which she would fill with the plaster-of-Paris paste and after inserting the catheter into the bladder, would strip it backwards forcing the paste into the bladder. At other times when a catheter was not available the same performance was accomplished with a strip of paper rolled into a tube.

Case viii. A student nurse (M. McC.) whose urological examination was negative and whose attacks of renal colic suggested hysteria, was told it seemed strange that her attacks always occurred at night and that none of the stones were recovered. Within a few days she had another attack and this time produced a "stone" for our inspection. It proved to be a small piece of cinder.

In conclusion, the various topics may be summarized as follows:

1. Delayed passage of small ureteral calculi may often be facilitated by ureteral instrumentation, either with the ureteral catheter or bougie or specially devised instruments.

Such manipulations are not wholly without danger.

The migrating ureteral calculus is always a cause for worry, being capable of seriously frustrating efforts for its removal.

Calculi of unusual size lodged in the lower ureter frequently require operative removal either by ureterolithotomy or ureteral meatotomy. Ureteral meatotomy by surgical diathermy is preferable to that by incision.

All urologists recognize that bilateral renal calculi usually manifest a state of advanced renal infection, seldom of the same duration in the two kidneys, hence an unequal degree of renal impairment, and present problems that demand the exercise of trained judgment in the adoption of a program of surgical interference.

Calculus in the solitary kidney is cause for apprehension, the risk of operation being dependent upon the function and the

degree of infection.

The combination of stone and renal tuberculosis is rare and it may be inferred that in such instances the stone is the primary lesion.

3. Difficulty of diagnosis of renal and ureteral stones by x-ray is most common when the stones are very small, and especially when composed of uric acid. Cystine stones are sometimes transparent to x-ray. The urogram will often make visible a stone transparent to unaided x-ray. The "staining" quality of certain media, such as sodium bromide, sodium iodide, uroselectan and skiadan, has been found helpful.

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Extrarenal shadows may usually be differentiated by the lateral x-ray and pyelogram and stereoscopy.

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DISCUSSION OF PAPERS BY DRS. LUBASH AND HAMER

Dr. Clarence G. Bandler: While cases of renal and ureteral calculi are not encountered frequently, one hopes to find a case having a separate blood supply to the affected portion of kidney, such as Dr. Lubash demonstrated. Just today, in our department at the Post-Graduate, we encountered the second case in a few months, of ureteral and renal pelvic duplication, with but a single ureteral orifice, in which the patient presented the picture of hydroureters with pyohydronephrosis. Of course, in this case, nephrectomy with ureterectomy is indicated.

Dr. Hamer has given us a very complete and interesting résumé of ureteral and renal lithiasis, in which he shows that these problems in Indiana, in no way differ from similar problems elsewhere. In reference to small stones in the ureters, it is a well known fact that about 70 per cent will pass spontaneously, or assisted by some form of intraureteral manipulation. Dr. Hamer's quotation from the statistics of the Crowell Clinic, whereby they obtained calculi by ureteral manipulation in 87 per cent of their cases, is extremely interesting, and amply illustrates the reward of patience. I believe all of us have employed multiple catheters, ureteral spindles, wire corkscrew manipulators, dilating bougies, ureteral bags and numerous other devices with some success; however, I am convinced that ureteral catheters and bulbous bougies are more frequently useful in manipulating stones out of the ureter through dilatation, than other types of ureteral instruments. If ureteral calculi are apparently fixed in their positon, and even their axes cannot be

changed by intraureteral manipulation, I believe that ureterectomy should be performed rather than allow these stones to remain fixed so long that irreparable renal damage may occur.

It is surprising how readily some very large calculi may be manipulated from the lower end of the ureter. No doubt, most of you recall a case presented before the urological section last year, by Dr. Dourmashkin, in which, with his dilating bag, he was successful in manipulating a calculus, 11/2 in. long, out of the lower end of the ureter. You may also recall that at the same meeting, another gentleman presented a calculus fully 21/2 in. in length, and irregular in shape, which also had been manipulated out of the lower end of the ureter.

In patients with bilateral ureteral calculi, one cannot afford to spend so much time in manipulation as with unilateral cases. If there is not a reasonably prompt response to intraureteral manipulation, surgical intervention is indicated. Dr. Hamer's reference to extensive bilateral renal calculi, and his enunciation of the principle that it is usually preferable to operate upon the better functionating kidney first, are reasonably tenable. However, the apparent facility of removal of such stones should have greater weight in influencing our judgment. With this in mind, we not infrequently operate upon the poorer functioning kidney first, with more satisfactory surgical results. I am convinced that some patients with multiple or large branched calculi in each kidney, live longer if no surgery is performed, than if they were subjected to the great risk of surgical intervention.

With the modern urologic tendency toward conservative renal surgery, it is surprising how many kidneys with multiple calculi or large branched calculi may be saved, where. formerly, it was common practice to nephrectomize these organs; now pyelotomy with intrapelvic manipulation and removal of these stones is very frequently successful. Occasionally, through a pyelotomy incision, a branched calculus may be crushed with a rongeur, and the fragments removed from the kidney. Kidneys with little or no renal function, as measured by dye output, will frequently return to a moderate and useful degree of renal activity. Dr. Hamer has referred to the coincident existence of lithiasis in cases of renal tuberculosis, and has quoted Crenshaw's statistics of 1.8 per cent of such cases in a large series at the Mayo Clinic. I do not believe renal calculus in these cases offers a separate surgical problem, but that the surgery indicated for the renal tuberculosis should also be that of the lithiasis. For instance, I doubt if in bilateral renal tuberculosis with a coincident calculus in one kidney that there would be any separate surgical indication for the treatment of the calculus.

DR. HOWARD S. JECK: Dr. Lubash stated that he regretted not having removed the ureter corresponding to the kidney pelvis in his heminephrectomy for fear that the ureter might later give rise to trouble. I believe, in this connection, he has little or nothing to worry about for the great majority of cases of empyemas of the ureteral stump occur in cases where stones have been left in the ureter or where there is some other form of obstruction. His case apparently had no ureteral stone and as far as I could tell from the urogram, there was no obstruction below.

Dr. Hamer referred to methods of removing ureteral stones by means of various devices, some of which actually grasp the stone. I well remember my experience with the flexible bougie that had a sort of a corkscrew at the end. The stone is supposed to be entangled in the coils of the corkscrew. The first time I used this instrument, I had beginner's luck. Within two minutes after I had started, I removed the instrument together with the stone and said, "What a bright boy am I." But the next time I tried the same instrument I thought I was going to remove the whole lining

of the urethra before I could pull the instrument out and I have therefore never used it since.

Some years ago at Bellevue, in another stone case, one of our men passed up the ureter a flexible metallic instrument with a head shaped a great deal like a spermatozoan. When the instrument was removed, the head remained in the ureter as was beautifully demonstrated by the x-ray. However, this particular foreign body passed out spontaneously within a few days.

Concerning operations for bilateral renal calculi, Dr. Hamer quoted the rule, which is usually followed, of operating on the better kidney first. Dr. Bandler also substantiated Dr. Hamer's remarks. We all agree that there are exceptions to this rule and one of the most striking exceptions I think is well illustrated by a patient on whom I recently operated at Bellevue. There were stones in both kidneys, the function of which was very poor. However, the left kidney was functioning somewhat better than the right. In this case I chose for the first operation the kidney with the poorer function (right) on the ground that had I operated upon the left kidney first and had nephrectomy become necessary, the right kidney probably could not have sustained life. And I doubt very much if the patient would have lived had only a nephrotomy on the right side been necessary. Incidently, as it turned out, the kidney and ureter were so friable that in trying to remove the stone, the ureter was accidently pulled in two at its junction with the renal pelvis. But fortunately an anastomosis between the ureter and kidney pelvis performed immediately after the stone was removed saved the day as well as the kidney.

In operating on a single kidney containing a stone, I think the point brought out by Dr. Keyes in his recent article on the subject was very well taken, namely, that we can probably operate successfully on more of these cases than we do. He ascribes his success to being more careful than when the patient is possessed of two kidneys and also to the fact that such a kidney being already infected, there is less likelihood that a severe acute infection will ensue.

Another of Dr. Hamer's points that I think is worthy of emphasis is the fact that every renal or ureteral stone case, particularly the latter, should be x-rayed immediately before the operation. Ureteral stones have a habit of changing their position on short notice and to

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my sorrow I have operated upon at least 2 patients in whom the stone was in the kidney pelvis at the time of the operation when it was shown to be well down in the ureter by an x-ray taken a day or two before the operation.

In operating for kidney or ureteral calculi, particularly the latter, I think it is of the greatest importance to try to open the ureter immediately over the stone. It is difficult to fish a stone out through a ureteral wound which is made several centimeters above or below the point where the stone lies. A good rule to follow is that once having gotten your fingers around a urinary stone, not to turn loose until you actually have the stone out.

Dr. C. R. O'Crowley: In regard to heminephrectomy: When Dr. Papin of Paris was here last June, at the close of the Urological Meeting in New York, I gave an operative clinic at the Newark City Hospital, at which Dr. Papin did a heminephrectomy and I assisted him. The patient was a woman twentyfour years old with a double pelvis kidney with two ureters that bifurcated about 6 in. below the kidney. The lower portion of the kidney had a small abscess cavity containing a small calculus. He did a beautiful resection in this case by removing a large wedge-shaped portion of the lower pole and then sewed with number zero catgut a small opening into a calyx. A fat pad was placed in the wound and the kidney and capsule closed over it. The operative wound was closed without drainage. A few days following operation she had a chill with rise of temperature and it was necessary to open the wound slightly, let out some pus and insert a drain. She drained pus and then urine for some time and finally the wound closed. She left the hospital and a few weeks after the wound opened up again and she returned to the hospital at which time we treated her the same way and at the same time did a uroselectan study of that kidney. It showed that a small portion of that lower ealyx was still there and was communicating both to the middle calvx and through the lower pole. I believe eventually the kidney will have to come out.

This is not a hazardous operation and I think more of such operations ought to be done in ideal cases.

Those of us who have had a large experience in nephrolithiasis have come to some very definite ideas which are not very far removed from those stated by Dr. Hamer. It is true that a very large percentage of stones pass of themselves and that the remaining percentage can almost always be encouraged to move by the various methods of intraureteral manipulations we are accustomed to, but I believe that all of these manipulations should show some result and that operation in some cases should not be put off too long, particularly, in those cases where we can demonstrate that manipulations, colics, and all forms of treatment have failed.

It is my opinion that in cases with calculi in both kidneys, it is wiser to operate upon the better kidney at first in order to raise its standard in case you operate later on the opposite side and may be compelled to do a nephrectomy.

Dr. J. STURDIVANT READ: I agree with Dr. Hamer that the removal of ureteral stones can generally be accomplished by manipulations with a ureteral catheter. Stones in the ureter which will allow the passage of a catheter alongside them can be assisted in their passage by allowing the catheter to remain in situ one or two days. In my own clinic, we are impressed by the mechanical ingenuity of some of the instruments advocated for the removal of ureteral stones. Frequently we think their advocates forget the delicacy of the mucous membrane and the small caliber of the ureter. I must say that most of these mechanical contrivances are now museum specimens. Fifty per cent of ureteral stones will be passed spontaneously and this should be taken into account in discussing the removal of stones by various manipulations.

The subject of closing the skin wound after nephrectomies has been mentioned. I have never seen any such wound delayed in healing up by putting in a drain, and I think it best that a drain should be used in every case. Where this is not done, there are about 2 per cent in which when the skin wound has healed, pus would accumulate in the bed of the wound and burrow in the wrong direction and not be discovered for a long period. Sometimes it necessitates a real operative procedure for its relief.

Records from our clinic at the Long Island College Hospital of 102 successive stone cases, show that there were 47 per cent right, 38 per cent left, bilateral 11 per cent. Of this, 70 per cent were in males, 31 per cent in females. Of these 102 cases, 58 came to operation; 28 nephrectomies, 23 pyelotomy, 1 pyelonephrot-

omy, 3 nephrostomies. The necessity for the suspension of the kidney after pyelotomy was thought to be indicated in 3 of these cases only.

individual judgment of the specific case. The damaged kidney may be improved for one to two years, but generally a secondary operation



Fig. 1.

The routine suspension of kidneys after pyelotomy is unnecessary. In the analysis of 13 cases of bilateral stone, 5 were nephrectomies on one side and later a pyelotomy was done. There were no deaths. The 3 nephrostomy cases were all in women, ranging in age from fortyeight to sixty-three, in which there were large branching calculi of each side. Pain was so great and sepsis so profound, that relief was sought. One died the fifteenth day postoperative of interstitial nephritis. The second died the same day, and the third, aged forty-eight, made a remarkable recovery though at the time the picture was one of intense pain and profound systemic retention. Yet she is now vigorous and well after six months' period. Generally it is wise in cases of large branching double calculi not to operate except for severe pain or great sepsis. I believe that regular dilatation of the ureters and lavage of the kidney pelvis retard the rate of progress of kidney destruction.

When to save a badly infected kidney in which there is a large branching calculus or many large calculi must always be a matter of

because of surgical difficulties is a much greater hazard. Also in our experience there is apt to be a recurrence of calculi in one to two years, so that if either kidney is undamaged except for the presence of a single small stone, we prefer nephrectomy. A case in point is a man, aged forty-nine, in whom eleven years ago 3 large phosphatic calculi were removed from the kidney. It was necessary to injure the kidney parenchyma while doing this. After two years, x-ray shows recurrence of this phosphatic calculi. There has been a permanent renal fistula which at times closes and produces systemic symptoms. After four years the left ureter became blocked by fibrotic and calcareous material at the junction of the ureter and pelvis. This has been a constant source of damage and has made the man a semi-invalid. The small calculus on the other side has not increased in size during these eleven years, and has given no pain or hematuria, though there is a moderate number of pus cells always. This kidney has been lavaged once in four months regularly.

The second case is that of a man now aged

fifty, with double calculi, who was seen nineteen years ago and has been under constant observation since. There were 2 large phosphatic

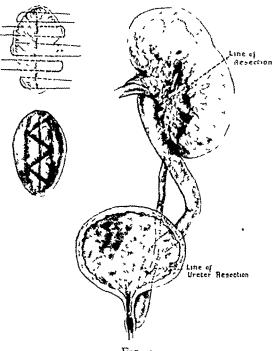


Fig. 3.

calculi on the left side and a nephrectomy was done. Two years later a pyelotomy was done on the remaining kidney. There was no post-operative shock. There has never been any recurrence. The patient has been in perfect health. This man is lavaged once in six months regularly.

We doubt if there is such a thing as a silent stone. All of these patients have some sort of pain at some time, mostly a dull backache to which they become so accustomed that unless a very careful history is taken, they will state that they never had any pain in the affected side. In the presence of regularly appearing small amounts of pus cells, and clear urine which has been secured by catheter, separate kidney urines should be secured, and if the pus should prove to be consistently from one side only, the presence of stone should be diagnosed even if v-ray findings are negative. This does not necessarily mean surgical procedures, but it does mean dietetic measures, occasional urinary antiseptics, and bi-yearly dilatation of the ureter with lavage of the pelvis.

Dr. Edward L. Keyes: The fundamental physiological fact in relation to ureteral stone

is that the stone advances only during periods when there is no colic or pain. These symptoms mean retention, and the most certain way to make all ureteral stones pass would be to perform bilateral pyelostomy. The relief of back pressure, when this operation is performed for the relief of calculous anuria, permits the silent passage of extraordinarily large stones. Conversely manipulation calculated to irritate the ureter will, if anything, delay the passage of the stone. Obviously not all stones that pass after ureteral manipulation can be credited to the manipulation. I have had no luck with the passage of several catheters up the ureter to expedite passage of stone. A single catheter seems to do as well. Indeed in most instances, there is no need to interfere at all.

DR. MEREDITH F. CAMPBELL: I have here the urograms in 2 cases which I thought might be of interest in connection with the first paper. The patients were both infants. I will not go into the details of the cases.

The first urogram (Fig. 1) is in a patient six months of age with a history of pyuria since birth. This is a "cystogram." It is obvious that an anomalous condition exists. It was found that the catheter entered a ureteral orifice on the floor of the mid-urethra. The second urogram (Fig. 2) shows the right pelvis injected and normal. The lower left renal pelvis is injected and normal and the catheter in the ectopic ureter shows a hydroureter and hydropyonephrosis of the upper pelvis. The urine from this upper left pelvis was milky with pus and functional tests indicated a dead kidney segment. The lower half and right side were normal. Heminephrectomy of the upper left kidney with ureterectomy down to about an inch from the urethral opening was successfully carried out (Fig. 3). The child's urine is now clear and sparkling and pyelogram taken one year postoperatively indicates a normal lower kidney pelvis.

The second case is that of a child first seen at the age of five weeks with a history of pyuria since birth. The urine was grossly purulent and at the age of six weeks the child was cystoscoped and it was determined that a congenital stricture of the left ureterovesical junction existed with infected hydroureter and nephrosis above. The kidney was functionally dead. On the right side there was a complete reduplication of the urinary tract with ureterovesical junction stricture and dilatation of the

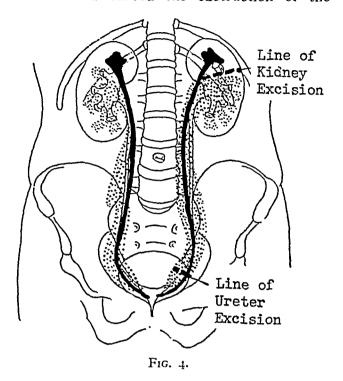
uretero to the lower pelvis, normal function and urine. Repeated search for a second ureteral orifice on the left side was fruitless till two years later. In the meantime conservative dilatation of the stricture by passing of multiple catheters served to restore partial kidney function and diminished infection. There were, however, periodic attacks of so-called "acute pyelitis." With the finding of the two ureteral orifices on the left side and the determining of a good functional upper left kidney half, ureteroheminephrectomy of the lower segment was successfully carried out (Fig. 4). The child is now cured except for a persistent urinary infection originating in the lower half of the right kidney.

Dr. S. Lubash (closing): As to Dr. O'Crowley's remarks regarding the heminephrectomy that was performed at his institution by Dr. Papin, I should like to point out that in Dr. Papin's recent talk before the American Urologic Association on conservative surgery he made mention of the fact that it was better to remove not only the diseased portion of the kidney, but to go beyond into normal areas rather than leave any of the infected material behind which would cause trouble in healing. This was also brought out by Judd in his very memorable work reported back in 1915.

Dr. Hamer, (closing): The discussion has brought out several points in regard to the spontaneous passage of ureteral calculi. Doubtless many of the patients who have been subjected to ureteral catheter manipulations would have passed their stones had no instrumentation been done. Yet there is ample evidence that the measure is entitled to much credit. Dr. Squire had record of 606 patients of whom 528 passed their stones following ureteral manipulations; 44 were operated on and 34 did not return. If Dr. Squire had been less modest he could have said that of the 572 patients treated 92 per cent passed their stones after ureteral manipulations.

Dr. Read's observation concerning fixation of the kidney after removal of a stone recalls an experience I recently had. After removal of a calculus by pyelotomy we were unable to find the ureteral outlet, and it developed that the ureter was angulated and bound down by adhesions. When these were broken up the ureter was freely open. I did not regard it as

necessary to anchor the kidney. It was not so much the position of the kidney as the adhesions which caused the obstruction of the



ureter. Maintaining the kidney in the normal position during convalescence probably accomplishes the same results as fixation. However, fixation should be done when indicated.

Conservatism in surgery of the kidney in bilateral stone is receiving much discussion at the present time. We are often in doubt whether pyelotomy, nephrotomy or nephrectomy should be done. The case of a young man with a large stone lodged in the mid-ureter of the right side and several large stones in the left kidney, illustrates this uncertainty. We removed the stone from the right ureter and drained the kidney by a small tube through the cortex. There was no urine from the bladder for several days and we were in doubt as to whether the left kidney had sufficient functional ability left to justify removal of its stones or whether it should be sacrificed. The left ureter was catheterized and it was found the kidney had some ability to excrete phthalein. The stones were removed and the kidney drained through a nephrostomy tube. The infection cleared up and the patient made a pretty good recovery but he has had a recurrence of stone on that side. Perhaps it would have been better to have removed his left kidney.

CARE OF THE

NEUROSURGICAL CASE*

S. Bernard Wortis, M.D.

NEW YORK

THE technique of surgical attack on the nervous system has been amply and often described by many masters. Such technique can only be created and applied by a surgical expert. However, the care of the patient before and after operation is equally the responsibility of physician and surgeon; it is of the first importance therefore that a procedure to that end, uniform, comprehensive and irreducible, be known to both physician and surgeon; and used.

We have set down here the method evolved, and now obligatory in the Neurological Department, Bellevue Hospital.

ROUTINE FOR ALL SURGICAL CASES

- 1. Complete medical examination (heart, lungs, rectal, vaginal).
- 2. Examination by neurologist. Obtain his signed opinion in favor of operation.
- 3. Temperature (rectal) every four hours, two days preceding operation.
- 4. Urine to laboratory, preoperative and postoperative and every week thereafter.
- 5. Blood typing. Save serum for cross agglutination.
 - 6. Blood coagulation time.
 - 7. Blood Wassermann test.
- 8. X-rays. Brain cases anterior, posterior and lateral stereoscopic views of skull. Spine cases anterior, posterior and lateral stereoscopic views of spine. Peripheral nerves anterior, posterior and lateral stereoscopic views of traumatized limb.
- 9. Never use hot water bags, hot pads, poultices or lighted cradles.
 - 10. Signed operative permit.
- 11. Urotropine grains x plus sodium acid phosphate grains x, t. i. d. postoperative on catheterized cases.
- 12. Never catheterize the patient for the first time unless he has been seen by the house doctor.

13. Blood count (white blood corpuscles and differential) and urine examination on all postoperative patients having a temperature of 101°F. or over after second day.

OPERATING ROOM PREPARATIONS

- 1. Thoroughly scrub the part to be operated upon with sterile soap and water for at least fifteen minutes.
- 2. Wash with alcohol on sterile towel, twice.
 - 3. Pat with ether on sterile towel, twice.
 - 4. Paint with 3.5 per cent iodine solution.

BRAIN CASES

General:

- 1. Magnesium sulphate retention enemas oz. 4, once daily.
- 2. High glucose diet. Limit fluid intake to 500 or 800 c.c. daily.
- 3. Glucose rectal taps oz. vi of 5 per cent solution if dehydrated.
 - 4. Sedative night before operation.
- 5. Caffeine sodium benzoate grains vii ss. hypodermically, twice or thrice daily.

Preoperative:

- 6. No food for eight hours preoperative.
- 7. Soap suds enema three hours preoperative.
 - 8. Shave entire head.
- 9. Give no morphine unless directly ordered by attending physician. (If giving morphine, give with caffeine. Dose for dose, morphine grain ¼ with caffeine sodium benzoate grains vii ss.)

A suitable blood donor should be available throughout the operation in all cases.

Postoperative:

10. Elevate head of bed slightly (unless cerebellar). Wound down to pillow if drained.

^{*} Submitted for publication November 12, 1930.

- 11. Keep warm with warmed blankets. Avoid draughts.
- 12. Two hundred fifty c.c. 25 per cent glucose solution (intravenously) on return to bed and daily for three days.
- 13. Rectal taps of 5 per cent glucose oz. vi every four hours while indicated, if dehydrated.
- 14. Pulse and respiration every fifteen minutes for six hours, thereafter every four hours.
- 15. Blood pressure every hour for six hours, thereafter every four hours.
 - 16. Rectal temperature every four hours.
- 17. Call house physician, if pulse rises 20 points or falls below 60.
- 18. Catheterize after eighteen hours only s. o. s. if ordered by doctor.
- 19. Soap suds enema on second day and thereafter p. r. n.
- 20. Diet first day 1 quart liquids with glucose (fruit juices). Second day 2 quarts liquid with glucose (fruit juices). Third day fluids ad lib. Thereafter increase to soft, etc.
- 21. Routine neurological examination first and third days postoperative and thereafter once a week.
- 22. Fundus examination by neurologist or oculist twice a week.
- 23. Dressing third to fourth day (remove sutures if indicated). Secondary operations not until fifth to seventh day.
- 24. Massage when feasible, starting fourth day.

SPINE CASES

General:

- 1. Particular care to skin to prevent bed
- 2. No hot water bags, hot pads, poultices or lighted cradles.
- 3. For urinary retention: express urine. Catheterize if necessary.
- 4. For fecal incontinence: high colonic irrigation daily.
- 5. Prevent contractures by postural changes.
- 6. Glucose rectal taps 5 per cent solution oz. vi every four hours, if dehydrated.

7. Air mattress.

Preoperative:

8. Shave back widely, above, below and to sides.

Include back of head to occiput for cervical cases.

Include region about arms for lumbar cases.

- 9. Nothing to eat for eight hours preoperative.
- 10. Soap suds enema three hours preoperative. If this gives no results follow by high colonic irrigation.

Postoperative:

- 11. Air mattress, bed flat.
- 12. Intravenous normal saline or glucose on return to bed (500 c.c.).
- 13. Rectal taps 5 per cent glucose oz. vi every four hours while needed.
- 14. Keep warm with warmed blankets. Prevent draughts.
- 15. Pulse and respiration every fifteen minutes for six hours, thereafter every four hours.
- 16. Blood pressure every hour for six hours. Thereafter every four hours.
- 17. Notify house surgeon if pulse rises 20 points or falls below 60.
- 18. Notify house surgeon if temperature rises above 101°F.
 - 19. Rectal temperature every four hours.
 - 20. Keep patient comfortable and dry.
- 21. Turn hemilaminectomies every three hours. Turn as a whole.
- 22. Turn bilateral laminectomies only after twenty-four hours.
- 23. Catheterize after eighteen hours only by doctor's orders.
- 24. Diet. First seventy-two hours only hot liquids, thereafter ad lib.
 - 25. High colonic irrigations for gas pains.
- 26. Massage limbs on fourth day. Thereafter, three times weekly.
- 27. For reduction of contracture exercise (even in bed) starting seventh day.
- 28. Soap suds enema on second day, and thereafter p. r. n.
- 29. Neurological examination on first and second days and twice weekly thereafter.

General:

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1. High glucose diet. Soft, semi-soft, or fluid.

TRIGEMINALS

- 2. Glucose rectal taps 5 per cent solution oz. vi every four hours, if dehydrated.
 - 3. Sedative night before operation.
 - 4. Digitalize if necessary.

Preoperative:

5. Nothing by mouth for eight hours preoperative.

6. Soap suds enema three hours,

preoperative.

- 7. When called to operating room, if general anesthetic is to be used, give atropine grains 150 and morphine grains 14 by hypodermic. If local anesthetic, morphine sulphate grains 14 and hyoscine grains 150.
 - 8. Shave only one side of head.

. Postoperative:

- 9. Eye shield over eye until corneal sensation has been established.
 - 10. Elevate head of bed slightly.
 - 11. Wound toward pillow, if drained.
- 12. Keep warm with warmed blankets. Avoid draughts.
- 13. Rectal taps of 5 per cent glucose oz. vi every four hours.
- 14. Pulse and respiration every fifteen minutes for six hours; thereafter hourly.
- 15. Blood pressure every hour for six hours; thereafter daily.
 - 16. Rectal temperature every four hours.
- 17. Soap suds enema on second day and thereafter p. r. n.
- 18. Diet ad lib. Fluids first day; soft second day, etc.
 - 19. Care of eye:
 - a. Eye shield.
 - b. Irrigate with boric acid solution every six hours.
 - c. Yellow oxide of mercury to lids.
 - d. 20 per cent argyrol gtts. ii into eyes if inflamed.
 - e. Notify doctor if inflamed or secreting pus.

- 20. Neurological examination:
- a. Area anesthesia
- b. Corneal reflexes weekly
- c. Motor power
- d. Cranial palsies
- 21. Dressing on second, fifth and eighth days.

Sutures out (if not subcuticular) on second day.

PERIPHERAL NERVE CASES

General:

- 1. Particular care of trophic sores.
- 2. Prevent edema by raising limb.
- 3. Prevent contractures by position of limb.
- 4. Do not use hot water bags, poultices or lighted cradles.

Preoperative:

- 5. Shave limb widely.
- 6. No food for eight hours preoperative.
- 7. Soap suds enema three hours preoperative.
- 8. When called to operating room for general anesthetic, give atropine grains ½50 hypodermically. For local anesthetic, give morphine grains ¼ and hyoscine grains ½50 hypodermically.

Postoperative:

- 9. Keep warm and free from draughts.
- 10. Rectal taps 5 per cent glucose solution if needed.
- 11. Pulse and respiration every hour for six hours; thereafter every four hours.
- 12. Blood pressure every hour for six hours. Thereafter every four hours.
 - 13. Rectal temperature every four hours.
- 14. Move patient to keep him comfortable.
- 15. Keep operated limb quiet and warm. Immobilize limb if ordered.
- 16. Elevate distal part to improve venous blood return.
- 17. Watch for oozing. Call house surgeon if pulse rises 20 points.
- 18. Watch limb distal to bandage. Notify house surgeon if it becomes blue, cyanotic or edematous.

19. Diet first day, fluids ad lib. Second day, soft diet, Third day, regular diet.

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- 20. Soap suds enema on second day, thereafter p. r. n. twice.
- 21. House surgeon to examine part distal to bandage daily.
- 22. Routine neurological examination weekly.
- 23. Dressing with removal of sutures fifth to tenth day.
- 24. Massage and galvanism on removal of splint.

25. Diathermy for painful sore.

In addition, the following routine is advisable for the reduction of increased intracranial pressure.

(1) Lumbar puncture.

- (2) Hypertonic glucose by vein (100 c.c. of 50 per cent solution three times daily).
- (3) Caffeine sodium benzoate grains VII ss. every four hours (hypodermically).
- (4) Rectal taps of 25 per cent glucose 4 oz. every four hours.

- (5) Elevate head of bed 15 to 45°.
 - Skull trephine with ventricular puncture in posterior fossa and third ventricle tumors.

If these measures prove inadequate,

(6) Right subtemporal decompression in comatose cases with marked papilledema that do not react to the previous procedures within two or three hours.

In conclusion, we have never regretted the inflexible rule in dealing with these cases, that both the neurological physician and the neurological surgeon must agree on the need for operation, before such operation be undertaken.

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· E D I T O R I A L ·

BOOTLEG SURGEONS

NEW breed of "cutter" has sprung up in various parts of the country. They are discovered in the poorer sections of densely populated communities. They are graduates of medical schools. They are licensed to practice medicine and surgery by the state in which they reside.

These vermin are without a semblance of surgical training. Many of them cannot boast of a six months' internship in a fourth rate hospital. Often they graduated from medical school within the past five years. They possess real insight into the psychology of human beings, have a thick crust, both mentally and spiritually, never did have a conscience, but their bump of business acumen is developed to the nth degree.

They open an office and personally call upon the general practitioners in their vicinity. They talk business from the start. The bootleg surgeon promises to use the practitioner when he can, for which he will be paid, and in return the general practitioner is to refer all his surgery to the "cutter" who will remit from 50 to 75 per cent of the fees charged. An equable arrangement for all parties. In no time the "carver" is doing a great volume of work. Needless to say all kinds of unnecessary surgery is done. The mortality is frightful. The morbidity never will be computed. But the patient always pays and pays. One of their favorite tricks is to give a hopeless prognosis. Should death follow their alibi is air-tight. If the

patient lives to leave the hospital or sanatarium the surgeon is a miracle worker.

Personally, we know several of this type. One of them not five years in practice already is independently rich. These surgical outcasts may be criticized but nothing can be done about it—not at the present, at least—except giving vent to indignation, as we are doing, for example.

The fault lies with our laws. One passes a state board examination and is launched forth to do surgery or medicine in any

or all its branches. No previous experience is necessary.

It is hurting the medical profession. It is unfair to the public. It is unfair to the young man who spends from two to five years as an interne or hospital resident to prepare himself for his calling.

Talk will get us nowhere. The laws need changing. Some of our medical practice acts need revising and long, sharp teeth added and then used.

T. S. W.

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Subscribers to The Ammin Journal of Surgary visiting New York City are invited to make the office of the publishers, Paul B. Hoeber, Inc., 76 Fifth Avenue, New York, their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly advise in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.

· CORRESPONDENCE ·

To the Editor:

The case of a patient ninety-three years of age, in whom union of a medial fracture at the hip was attained by the abduction treatment, to which you have called my attention, suggests to me, that your readers may be interested in a summary of a recent analysis of the treatment of the same type of fractures at the Massachusetts General Hospital by the same method.

According to Dr. Reggio the cases received at this hospital were the most unfavorable class. Yet in 70 per cent of the number (49 of 70) the abduction treatment was applied and in 66 per cent of the cases, in which it was carried to a conclusion, union was attained.

This percentage of repair presents a striking contrast to the results under the old system, as may be illustrated by recent statistics.1 In 1928 Katzenstein reported to the Surgical Society of Berlin on 169 cases of transcervical fracture treated by conventional methods. Good results were attained in 11.5 per cent, a percentage which, according to Axhausen who discussed the paper, might be accepted as representing the general experience.2

During the present year Hübner has reported on 136 fractures treated at the Charity Hospital of Berlin. Bony union was attained in but 6 per cent and passable function in 17 per cent of the cases.3 It may be noted incidentally that there is on record a report by Scudder on the final results of a group of 16 cases treated at the Massachusetts General Hospital in preabduction days. Of these it is stated, that in but two instances was there useful function.

The treatment of this fracture must be adapted to the patient as well as to the injury and from this standpoint Dr. Reggio's report is distinctly disappointing, since the death rate was 26.5 per cent, or

far higher than the average. It appears, however, that 9 of the 13 deaths (69 per cent) were in patients over seventy years of age, and that 7 might be classed as accidental or unusual, I from anesthesia, 5 from embolism and 1 from cerebral hemorrhage.

In a far larger number of cases of the same type treated by the same method reported by Löfberg the death rate was but 6 per cent. In a group of 77 cases treated by the staff of the Hospital for Ruptured and Crippled there were 5 deaths: one of pneumonia in a woman of eighty-eight, I of senile dementia in a woman of seventyeight four months later, 1 of advanced myocarditis and 2 from embolism.

At a recent symposium on the treatment of medial fractures, Anschütz of Kiel expressed the opinion "that any other treatment than by the abduction method was irrational and absurd." Mosenthal of Berlin said that there could be no discussion of the relative merits of a treatment that had, according to published statistics, raised the percentage of bony union to 73 per cent and in his own practice to 90 per cent of the cases. He concluded that the real obstacle to its general adoption was inability to meet its requirements.2

According to Hey Groves there are but two methods worth consideration, the abduction treatment and open operation.

These conclusions refer only to medial fractures, in which the question is of direct repair, but they apply equally to those at the base since the abduction method is the only effective means of reducing resistant deformity, the essential preliminary of normal function which in the past has received no consideration whatever.

The question at issue is of standard, whether it shall be positive or negative. What, in anticipation, may be termed the

Reggio, A. W. J. Bone & Joint Surg., 12: 819-826,

<sup>1930.
&</sup>lt;sup>2</sup> Zentralb. f. Chir., 55: 322-327, 1928. 3 Arch. f. Orthop., May 1930.

¹ Zentralb. f. Chir., 54: 2184-88, 1927.

² Med. Klin., 25: 463, 1929. ³ J. Bone & Joint Surg., 12: 1-11, 1930.

old teaching is based on the assumption that the result is practically determined by the character of the injury and that positive intervention is essentially hazardous and futile. The typical patient presented to the student is aged and infirm and the characteristic fracture that which is least capable of repair.

The abduction treatment is the exponent of radical reform, simply because it is in accord with the standard that governs the treatment of all other fractures. It is, therefore, primarily concerned with that neglected and submerged class, in which the treatment of the fracture is manifestly practicable.

This class is represented by the 120 cases of ununited fracture reported by Henderson¹ of the Mayo Clinic but 5 of which were in patients more than seventy years of age. Of 1-0 cases recorded at the Hospital for Ruptured and Crippled but 15 per cent were in patients over seventy. Only 52 were seen within a week after the injury. The remainder represented inefficient treatment and neglect.

When it is officially conceded, that fracture of the neck of the femur is amenable to the rules that govern the treatment of other fractures, and entitled, therefore, to the same moral and legal protection from incompetence and neglect, there can be, in a comprehensive sense, no alternative to the abduction method as a basic routine, and those who have trained in its application will find little occasion for substitutes.

Very truly yours, ROYAL WHITMAN

To the Editor:

In the March number of the AMERICAN JOURNAL OF SURGERY my attention was called to a paper on spinal anesthesia by Dr. Meyer Saklad. Amongst others he refers to a criticism of the Pitkin method which I wrote and which appeared in the Lancet in January, 1930. He draws conclusions from that criticism which I had not drawn and did not intend should

be drawn. It is notoriously difficult to say what one means and it is obvious that I have failed to do so in this case. With your permission I will endeavor to set the matter right. Dr. Saklad divides spinal anesthetists into two categories, those who think a fall in blood pressure is of little or no consequence and those who think that it is a serious matter. He puts me in the former category. But I refuse to be so limited. It is a question of the patient and the circumstances. That an enormous fall of blood pressure even up to 75 per cent does not matter in the vast majority of cases is obvious from the fact that the vast majority of patients who have this fall recover. So though we may state it as a rule to which there are but few exceptions that a fall in blood pressure due to spinal anesthesia itself can be regarded with equanimity (provided the Trendelenburg position be used) yet the few exceptions are important. There is the patient with narrowed coronary arteries who needs all his blood pressure to force the blood to his heart wall. He will die if his blood pressure is lowered. He will die soon of course in any case. Then there is the patient whose blood pressure has been lowered 50 per cent by spinal anesthesia and the operation (extensive manipulations intra-abdominal) produces shock, because stimulating nerves (the vagus) not affected by the anesthetic. The blood pressure goes still lower and the patient may die of heart failure. Though the special anesthesia has not caused the death it has prepared the way for it. It is easy as a rule to prevent such a death if you are on the qui vive and if you can get an intravenous saline injection given at once.

Secondly, Dr. Saklad says that Donald and I conclude that the use of this viscid solution of lighter specific gravity than spinal fluid is no more controllable than novocaine or neocaine crystals dissolved in spinal fluid and used as the anesthetic agent. I have drawn no such conclusion. I agree with Drs. Donald and Saklad that it is not as controllable as Pitkin

¹ Surg. Gynec. Obst., Feb., 1920.

leads us to suppose. Seeing that the height of and duration of anesthesia are dependent on so many factors such as the dose, the height and weight of the patient, whether he is very ill or not, the force with which the injection is given, anatomical differences and absolute controllability are somewhat illusive. It is difficult for one individual to have a large experience of different methods and I have very little experience of non-viscid solutions. I am relying on the opinion of Profs. Forgue and Basset who have had twenty years' experience with them. Now they say they get vomiting about the twentieth minute so often as to be the rule. "A cette dose minima, l'agent chimique excite surtout le centre du vomissement: de là, ces nausées, cette poussée de vomissements de la vingtième minute, qu'il est classique . . . " Also they never use more than 120 mg. Now with the viscid solution vomiting except that due to visceral manipulation is rare. This means that the viscid solution does not diffuse, does not excite the vomiting center, is therefore more controllable. For a high abdominal operation I never use less than 250 mg. that is double the dose recommended by Profs. Forgue and Basset. It is the viscidity which makes this much larger dose possible, it slows the absorption and the excretion and so gives us a much longer time, roughly twice as long (ninety minutes as against forty-five given by Profs. Forgue and Basset as their average). Again, Profs. Forgue and Basset quote with approval the sixth observation of Pitres and Abadie which is to the effect that in an area of full anesthesia islands occur in which the analgesic has taken no effect. This has never happened in my experience with the viscid solution. So in these three particulars, the absence of widespread diffusion, the increase in the length of time and the regularity in the disposition of the anesthetic the viscid solution is more under control than the mobile.

American Journal of Surgery

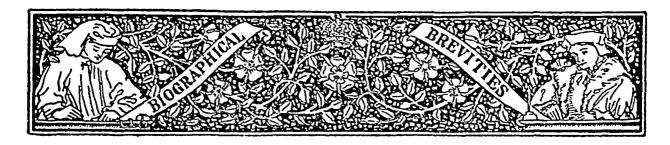
Thirdly, Dr. Saklad says, "Both Donald and Hill reach the conclusion after a

study of ephedrine that it does not prevent a fall of blood pressure." I am still using it and in 100 mg. doses so I presume I have some reason for so doing. I am of opinion that it frequently has an effect in keeping the blood pressure steady but many times the blood pressure falls heavily in spite of ephedrine. As an example: On Saturday last, April 18, a man aged sixty-seven suffering from gangrenous appendicitis and general peritonitis, had a blood pressure of 140 before operation. I gave him 100 mg. of ephedrine followed by 270 mg. of novocaine contained in 2.7 c.c. of duracaine. Fifteen minutes later his blood pressure was 60 and ten minutes later still it had gone to 50 mm. Hg. The next day a man aged thirty-two with a kidney affected with tubercle was treated in exactly the same way as far as the anesthetic was concerned. He was given 100 mg, of ephedrine followed by 270 mg, of novocaine in 2.7 c.c. of duracain. His blood pressure before the operation was 110, at the end of the operation one and one-half hours later his blood pressure was 140 and in the meantime had always been between these two figures. The operation was so long partly on account of the size of the kidney which weighed 27 oz., 765 gm., and partly due to the fact that the ureter was dissected out anteriorly and divided by the cautery. The anesthesia in both cases was completely successful in the sense that it was neither too high nor too low and neither patient wished to be made unconscious and both are making good recoveries. Whatever effect ephedrine may have over the fall of blood pressure due to the anesthetic it appears to have little or none in preventing the fall which sometimes occurs later due to shock caused by intra-abdominal manipulations. This latter may be entirely replaced by a rise to normal by an intravenous saline 1/2 1. together with an intramuscular injection of pitressin. Pitressin is to be preferred to adrenalin in these cases.

E. FALKNER HILL



NICHOLAS SENN [1844-1908]



"SENN'S TEST"

ICHOLAS SENN was born in Buchs, Canton of St. Gall, Switzerland, October 31, 1844. He was brought by his parents to the United States in 1852. They settled in the town of Ashford, Wisconsin. He graduated from the Fond du Lac High School, Wisconsin, 1864, taught school for two years and at the same time read medicine with Dr. Munk. In 1868 he graduated from the Chicago Medical College with the degree of M.D. After an interneship of eighteen months in Cook County Hospital he moved to Elmore, Wisconsin, and began the practice of medicine. In 1874 he moved to Milwaukee but three years later went to Germany to study, returning in 1880, at which time he was called to be professor of surgery in the College of Physicians and Surgeons, Chicago. In 1884 he was made professor of the principles and practice of surgery at the same college. In 1888 he became professor of surgery and surgical pathology in Rush Medical College and in 1801 at Rush succeeded Charles T. Parkes in the chair of practice of surgery and clinical surgery. In addition he was professor of surgery in the Chicago Polyclinic. He was chief surgeon to several hospitals.

Early in his career he did much research work in abdominal surgery. He was a leader in this field. In his researches in intestinal perforation, especially in gunshot wounds, he introduced hydrogen gas into the rectum; then a light was held near the coils of intestines and in this way the point of perforation discovered by the igniting gas (Senn's test). Senn also employed plates of decalcified bone in intestinal anastomosis. He is responsible

for much of our modern ideas of surgical tuberculosis. In 1885 he published an excellent book on "Surgery of the Pancreas." He was a rapid and voluminous writer. He wrote at all times, seldom using reference works. This resulted in loose, slipshod work and although he is credited with 160 volumes, few had more than a short life.

Senn was the first in the West to conduct experiments on animals and report his conclusions. In 1896 he delivered the surgical oration, and in 1897 was president of the American Medical Association. He saw service in the Spanish American War. He gave wonderful books, especially of the older writers, to the Newberry Library. He endowed the Senn room in St. Joseph's Hospital (Chicago) where he was confined in his last illness. To Rush Medical College he gave a clinical building at an approximate cost of \$100,000.

Senn was a pioneer pathologist in this country and brought it into practical application with his surgery.

He was short, thick set, nervous, untiring, simple minded, sympathetic. He founded no school; neither did he train younger men to carry on from where he left off. He was jealous of competition.

In his later years he was widely travelled and wrote of what he saw and experienced. On what was to be his last trip he climbed a mountain 16,000 feet high which was responsible for a cardiac dilatation. Returned home he rapidly grew worse, entered a hospital and died, leaving a widow and two sons, both physicians, at the age of sixty-four years, on January 2, 1008.

T. S. W.



[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

THE "BYRTH OF MANKYNDE"*

THE 1540 EDITION

Charles A. Gordon, M.D., F.A.C.S.

BROOKLYN, N. Y.

In the library of the Medical Society of the County of Kings, of Kings County, Brooklyn, New York, is a perfect copy of Richard Jonas' "Bryth of Mankynde" imprinted at London by T. R. in 1540. This, the first edition of the first book on obstetrics printed in English is commonly referred to as Raynalde's "Byrth of Mankynde."

It is a translation of "De partu hominis et quae circa ipsum accidunt, Libellus D. Eucharii Rhodionis, Medici," the Latin edition of "Der Schwangern Fravwen und Hebammen Rosengarten," by Eucharius Rösslin, which was first printed at Strassburg in 1513, and translated into Latin in 1532, first at Frankfort.

Certainly the most interesting book on obstetrics in English, this edition is extremely rare and of great interest as the very beginning of all our obstetric literature. Though J. H. Aveling in 1875 discovered in the British Museum a manuscript of the fifteenth century, "vellum in quarto, beautifully written and illuminated, two hundred thirty-four pages of which are devoted to Midwifery and the Diseases of Women," it had never been printed and never became popular like the "Byrth of Mankynde," which was

printed again in 1545, and ran through one edition after another until 1654. For over a hundred years the only textbook in English, it was frequently revised without the addition of much of importance.

It is not my intention to describe the "Byrth of Mankynde" minutely, as that was brilliantly done by J. W. Ballantyne of Edinburgh in 1906. He, however, never saw a perfect first edition, as the British Museum copy, the only one to which he had access was "imperfect, consisting of but 84 numbered leaves instead of 86 in Herbert's [Heber's] copy, and it lacks the plates." A copy in the library of the Obstetrical Society of London and another in the library of the University of Glasgow, said to be 1540 editions, were rejected by him.

Heber's copy described by Dibdin in 1816 as perfect, "had 86 numbered leaves, quarto, stout paper, fine large Gothic type." Ballantyne thought his description exceedingly valuable on account of the great rarity of this edition. Dibdin gave the table of contents, and noted the presence of "Cum privlegio Regali, ad imprimendum solum" at the bottom of the title-page. "Between folios xxiv and v are four copper plate engravings containing seven

Read at a meeting of the Brooklyn Gynecological Society, December 5, 1930.

teen illustrations of children in utero," he said. This copy cannot be traced.

New Series Vol. XIII, No. 1

Gustav Klein of Munich in 1910 showed that there were fifteen English editions of Raynalde's book from 1540 to 1654, two or three more than Ballantyne was able to find, but of the first, or Jonas edition. he was sure there never was another.

Klein had in his possession a manuscript in quarto with the title "The byrth of mankvnde newly translated out of laten in to Englysshe." Fixing its date as not before 1535, and pointing out that no one would be likely to write out a book already in print, he concluded that his was the original manuscript. A treasure indeed.

Denman stated in 1794 that "Dr. Combe has in his possession the identical manuscript copy of this work, which was presented to Catherine, Queen of Henry the VIII. This copy is signed with the name of - Jonas, but it does not appear why the book was afterward published by Raynold in his own name." This manuscript in 1840 was in the possession of T. J. Pettigrew, who briefly described the 1540 edition "as of exceeding rarity."

Sir D'Arcy Power states that after the death of Mr. Pettigrew in 1865, it was sold at Sotheby's to a dealer, and passed, he believes, into the hands of Dr. Lloyd Roberts of Manchester. He does not, however, know its present whereabouts, and knew nothing of Klein's claim to ownership. Nor was Klein aware of the previous whereabouts of his manuscript, nor does he say that Jonas' signature appears therein. It seems that it should.

Further search for the manuscript has proved fruitless. Dr. Lloyd Roberts died in 1920. Mr. Wilson, Librarian of the Manchester Medical Society and University of Manchester, was not aware that Dr. Roberts possessed the manuscript, but feels sure that if he did, it would be found in the Library of the Royal College of Physicians, London. It is not there, however, nor is it in Manchester. Gustav Klein too is dead; the major portion of his library went to the University of Louvain. The manuscript was not offered to them, and possibly was sold separately. There is no doubt of its existence somewhere, yet it

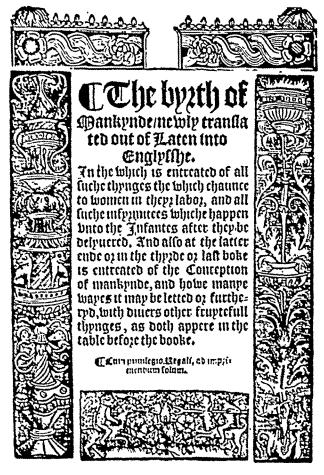


Fig. 1. Title-page 1540 edition.

The byrth of Mankynde / newly translated out of Laten into Englysche. In the which is entreated of all suche thynges the which chaunce to women in theyr labor and all suche infyrmitees whiche happen unto the Infantes after they be delyuered. And also at the latter ende or in the thyrde or last boke is entreated of the Concepcion of mankynde and howe manye wayes it may be letted or furtheryd, with divers other fruytefull thynges, as doth appere in the table before the booke.

seems strange that a treasure like this could survive the centuries, appearing in 1794, 1840 and 1910, only to vanish again. The story of its wanderings has yet to be told.

Klein also knew nothing of a description of our first edition by George Jackson Fisher, from whom we obtained it. Fisher, an ardent bibliophile, described it in 1881 quite completely, but not quite correctly as he had no knowledge of the important facts later unearthed by Ballantyne.

120

vnto the Quene. fol. vi.
Other most gracious land in all coof

Tinto the most gracious land in all goodnesse most excellent vertuous Lady Quene
Batheryne/wyfe and most derely belonyd spoule but o the most energyly
sapient Chasten paynee/kynge
Henry the. bin. Richard Ionas wyssheth perpetuals
toye and felicyte.

here as of late (most excellent vertious Duene) many
goodly and proper treatyles
as well concerninge holye
striptures wherein is onterstriptures where prophane artes and
striences right necessary to be known that
so show the paynefull dyligence
of suche clarkes which have embusyed them
in the same very earnestive and circumspective set forth in this oure walgare Englysshe
tinges to the greace encytchyinge of our mother langages and also the greate builte and
profet of all people plyinge the same same
anonge all other thyinges soure of the noble

Fig. 2. Dedication, 1540 edition. Unto the Quene. Unto the most gracious / and in all goodnesse most excellent vertuous Lady Quene Katheryn / wyse and most derely beloyvd spouse unto the most mighty sapient Christen prynce / Kynge Henry the viii Richard Jonas wyscheth perpetuall joye and felicyte.

segence of Whilyke have ben dynersi properi

.A25.ii.

Where as of late (most excellent vertuous Quene) many goodly and proper treatyses as well concerynge holye scripture / wherein is conteyned the onely comforte and consolatio of all godlye people: as other prophane artes and sciences ryght necessary to be knowen and had in use / have been by the paynefull dyligence of suche clarkes which have embusyed them in same very earnestlye and circumspectyle set forth in this oure wulgare Englysche tunge / to the great enryching of our mother language / and also the greate utilite and profet of all people usyng the same / and amonge all other thynges / oute of the noble scyence of Phisyke have been dyuers / proper /.

numerierte blätter hat und die Kupfertafeln enthalt; somit wäre mein Exemplar das einige bis jetzt bekannte vollständige Exemplar der Englischen Aufgabe von 1540."

It is my purpose to acquaint bibliophiles with the existence of another copy of this book.

For centuries authorship was erroneously attributed to Thomas Raynalde, a London physician, the T. R. in the colophon being held to mean him. Strange to say this idea was often referred to authoritatively. Ames and Dibdin who had seen the first edition, had failed to construe properly the dedication of the first edition by Richard Jonas in the light of the prologue of the second edition where Thomas Raynalde refers to:

. . . a certayne studious and diligent clarke at the request and desyre of divers honest and sad matrones, beynge of hys acquayntaunce, dyd translate out of Latin into English a great part of thys boke, entiteling it according to the Latine inscription (de partu hominis, that is to saye: of the byrth of mankynd) which we nowe do name (The womans boke) (for so moch as the most parte or well neare all therein entreated of, doth concerne and touche onely women). In whych his translation he varied, or declyned nothing at al from the steppes of his Latine auctor. Obseruynge more fydelyte in translatynge and alowyng many thynges in the same Boke, greatly neadyng admonityon and wary aduyse or counsell to the readers, whyche otherwyse myghte sometymes use that for a helpe, thee which shoulde turne to a hynderaunce, wherefore I reuoluying and earnestly reuysinge from top to toe sayd boke, and here withal considering the manifold utilite and profyte, which thereby moughts ensue to all women [as touching that purpose] yf it were more narrowly loked over, and wyth a strayghter iudgement more exactly every thing therein pondred and tryed, thoughte my labour and paynes should not be euyl employed, ne unthankefully accepted and receaued of al honest, discrete and sage women. If I after good and dylygent perusing thereof dyd correcte and amende soche fautes in it, as seemed worthy of the same, and to aduyse the readers what thynges were good or intollerable to be used, which were daungerous, and which were utterly to be eschued. The which thinge I have not only so done, but over this have

thereunto adioyned and annexed dyuers more experimented and more familier medicines.

By a strange coincidence there lived in London at the same time, two Thomas Raynaldes, the one a printer, at the Signe of the Star in St. Paul's Churchyard, the other a physician who practiced in London and Paris, and who may have been a relative of the printer. Richard Jonas, about whom nothing more is known, was the studious and diligent clarke referred to by the editor of the second edition, as the translator of the first. These facts seem to have been clearly established by the brilliant researches of Ballantyne who admits that "It is just possible that Thomas Raynalde may have been the maker of the translation of 1540, and that he took the nom de plume of Richard Jonas to save himself from the possible obloquy to the physician who concerned himself [in those times | with the subject of midwifery."*

The work is still called Raynalde's "Byrth of Mankynde," and has been for almost four hundred years, although the author of the first edition was Richard Jonas. Fisher was not deceived, nor was Robert Bland, but others were, until the question was definitely settled by Ballantyne. The first edition was revised "from top to toe" in 1545 by Thomas Raynalde, who added the prologue and other material. "He may have edited the third edition in 1552 and the fourth in 1560, but subsequent editions were almost identical, and probably Thomas Raynalde, the physician, had no hand in them."

THE 1540 EDITION

Our beautiful copy is in fine condition, bound in old red leather, and the finest

* Sir Wm. Osler in Bibliotheca Osleriana, Bibliotheca Secunda under item 3821 (Oxford, at the Clarendon Press, 1929) says: "Mr. W. H. Buckler, in a personal communication (1924), suggests that Dr. Raynalde, the editor, may have been a Thos. Raynolde of Merton College (B.A., 1518: Fellow, 1520) who, through the influence of John Chambre, physician to Henry viii, became chaplain to Queen Jane Seymour. This connexion and the fact that he visited Paris both have some significance (cf. Ballantyne, pp. 304-6). He should not be confused with Thos. Raynoldes, or Reynolds, B.A. in 1522, Fellow of Merton in 1526 and later Warden.'

specimen of black letter I have ever seen. The paper is strong, clear and hardly yellowed with age. Gothic was introduced into England by Caxton, who brought the art of printing there in 1457, and was employed extensively in a great many of the earliest presses all over Europe. It is now called lettre de forme, black letter, or English in English speaking countries.

Within its covers are the bookplates of Russell Plumptre and Robert Bland, and a note signed R. B. (Robert Bland) is care-

fully written.

This book was bought at Leigh & Sothebye, March 20, 1794, out of the library of Dr. Russell Plumbtre, many years Regius Professor of Physick in the University of Cambridge who lived to a very advanced age. I believe more than 90 years of age.* It is a translation of Eucharius Rhodion, De Partu Hominis, published originally in German, and first translated into Latin and printed at Frankfort in the year 1532 . . . But of the present translation which is exceedingly scarce, there never was another edition. R:B:

Plumptre filled the chair of Physick at Cambridge for more than half a century, dying in 1793, aged eighty-four. I have been able to find no record of his writings.

Robert Bland, however, a well known obstetrician who died in London in 1816, aged seventy-six, was the author of-

- 1. Some Calculations of the Number of Accidents or Deaths which happen from Parturition. 4to. Lond. 1781.
- 2. Observations on Human and Comparative Parturition. 8vo. Lond. 1794.
- 3. Proverbs, chiefly taken from the Adagia of Erasmus, with Explanations; and illustrated by Examples from the Spanish, Italian, French and English languages. 2 vols. 12mo. Lond. 1814.

The book is a small quarto containing 88 leaves or 175 unnumbered pages. The type matter on the back of folio 85 and folio 87 is transposed, through printer's error. The text on the back of folio 87 should be on the back of folio 85, and vice versa. This is exactly as in Klein's copy,

* Dr. Russell Plumptre, was born 1709, died 1793.

verso sind imsatz verwechselt." There are xxiv and xxv, not between folios xx and three Bokes, firste, seconde and thirde.

VNT O THE REDER Tan admonicion to the reader.

Op so muche as we have enterpysed the interpretation of this present boke, offering and bedicating it unto our most gracyous and vertuous Quene kate typn onely, by it myndyng and tendering the builte and wealthe of all women, as touchynge the greate parell & dangeours, which mofte commenly oppicately them in they, paynefull labours. I require all luchemen in the name of God, whiche at any tyme thall chaunfe to have this boke, that they ble at godlye, and onely to the profet of they neighbours, btterly eschuynge all rebawde and unsemely communi cacion of any thyinges contagned in the fame, as they well auswere before God, whiche as wetnesteth Christ, well require a counte of all yoell wordes, and muche more then of all revalude and bucharitable wordes. Eucry thynge, as fayth Salomon, hath his tyme, and trucly that is farre oute of tyme, yea and farre from all good honefie, that some vse at the commune tables and without any difference before all companyes rude= ly e and lendely e to talke of such ethyinges, in the which they ought rather to know emuche, and to saye lyttell, but only where it maye do good, magnifyeng the mygh tpe God of nature in all his workes, compassionatringe and pytyenge ourceuen Chaftians, the women whiche fustagne and enduce for the tyme to greate dolor and

papie for the byth of mankynoc and belyucraunce of the fame in to the worlde.

Prayle God in all his workes.

Fig. 3. Unto the Reder.

An admonicion to the reader. For so muche as we have enterprysed the interpretation of this present boke, offerynge and dedicatyng it unto our moste gracyous and vertuous Quene Katheryn onely, by it mynding and tenderyng the utilite and wealthe of all women, as touchynge the greate parell and dangeours, which moste commenly oppreseth them in theyr paynefull labours, I requyre all such men in the name of God, whiche at any tyme shall chaunse to have this boke, that they use it godlye, and onely to the profet of theyr neyghbours, utterly eschewing all rebawde and unsemely communication of any thynges contayned in the same, as they will answere before God, whiche as wytnesseth Christ, will requyre a counte of all ydell wordes, and much more then of all rebawde and uncharitable wordes. Everythynge, as sayth Salamon, has his tyme, and truly that is farre oute of tyme, yea and farre from all good honestie, that some use at the commune tables and without any difference before all companyes rudelye and leudelye to talk of suche thynges, in the which they ought rather to knowe muche, and to saye lyttell, but only where it maye do good, magnifyeng the myghtye God of nature in all his workes, compassionatynge and pytenge oure even Christians, the

for Klein says, "Blatt 85 verso and 87 The plates however are between folios xx1 as in Klein's copy. They are between 13 and 14 of the text description which is apparently their natural place. These plates are sewed in with a strong thread, in the same way and with the same thread that stitching is done in other parts of the book. A "Rosengarten" of 1528, and a "De Partu Hominis" of 1554, also in our possession, are sewed in the same manner with the same kind of thread. In every particular, save the location of the plates our edition collates perfectly with Klein's description.

Sir D'Arcy Power locates the plates as between folios xxxiv and xxxv. He has since corrected this to folios xxiv and xxv, agreeing with Dibdin's description of the British Museum specimen, and our copy. He is the first to state that there were two issues in 1540, one with "Cum privlegio Regali, ad imprimendum solum" on the title-page, the other without this privilege. It has been repeatedly stated that there was but one edition, and this is probably the fact. Power himself suggests that the printer after selling a number of copies issued the remainder with a new or altered title-page. The text was not reset since peculiarities in type and printer's errors are identical in the two issues, once the property of Dr. Lloyd Roberts and now in the possession of the Royal College of Physicians, London; one copy is not complete, however, lacking the birth figures.

The title page, [Power says] is of extreme interest. The ornament consists of four separate panels. The two side ones are not similar, that on the dexter side contains two small animals, that on the sinister side is a floral decoration ending in a burning censer. The lower panel represents a duel of monkeys, armed with a broom and a pitchfork, mounted on lambs. The real interest of the title page lies in the top panel. It consists of a rose and cable ornament with an empty shield in the center.

women whyche sustayne and endure for the tyme so greate dolor and payne for the byrth of Mankynde and delyverance of the same in to the worlde. Prayse God in all his workes.

Our copy, as well as Klein's, has the privilege and title-page as he describes. In a comparison of the ornamental initial letters which he has worked out as a means of identifying various editions, our copy collates perfectly with his description. The upside down "1" initial letter is an interesting example of the printer's troubles with the wood block. The "w" is said by Power to be a beautiful specimen of wood cutting.

THE "BYRTHE FYGURES"

There are four copper plate engravings on two pages, showing in all xvII illustrations of the fetus in utero, and the woman's stool. These are the famous "byrthe fygures" which appeared first as woodcuts in the German and Latin editions, themselves the earliest obstetrical figures printed from wooden blocks.

Martin Flack, Jr., the printer of Rösslin's book, had them cut by the famous woodcutter, Erhard Schön in 1513. Manuscripts found in Paris, Rome, Dresden, Copenhagen and Munich all show 15 to 16 positions of the fetus. Curious and purley imaginative as they are, it is interesting to note that a few years before, Leonardo da Vinci had sketched the fetus from postmortem observation of the opened uterus.

These copper plate impressions were made with a roller or a rolling press, and are of great interest typographically as, with one possible exception, the frontispiece to Galenus' "De Temperamentis," printed at Cambridge in 1521, they were the very first copper plate impressions seen in England. It is not known whether they were cut in England or not, but they probably were, as they do not compare at all favorably with other work of that period in Europe, where the greatest geniuses, as soon as the art of printing was spread abroad, threw themselves whole heartedly into the perfection of the new art. The great masters of design, who had earned fame by their work in cutting wood, soon found that engraving upon copper was much easier, with happier effects in anatomic illustration at least; the old art suffered, and the new became more perfect.

> BOKE. FOL. LXXXVIII.

declared / Whiche for breuite and Chortenesse We for this tyme do let palle I makinge here an ende of this transple, the whiche we have composed and translated oute of Laten 1 to the ho= nour of God 1 the vtilite and profette of all honeste ma= tronts.

Deo gratias.

CImplynted at Londoni by.T.R.

Anno Domini, M. CCCCC. AL.

Fig. 4. Last folio. Colphon. Declared / which for brevite and shortnesse we for this tyme do let passe / makynge here an ende of this treatyse / the which we have composed and translated oute of Laten / to the honour of God / the utilite and profette of all honeste matrones. Deo gratias.

Imprynted at London by T. R. Anno Domini M, MCCCCCXL.

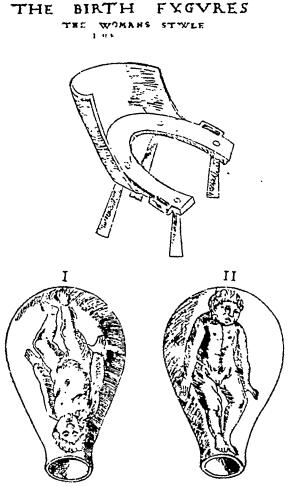
Printing however was in a deplorable condition in England at the end of the 15th century. The best evidence of this was the enactment of a law in 1483,

. . . by which any artificer, or merchant stranger of what nation or country he be of, was not to be hindred from bringing into this realm, or selling by retail or otherwise any books written or printed . . . which he hath, or shall have, to sell by way of merchandise—or from their dwelling within this said realm for the exercise of the said occupation.

The plates of the first edition up to now never have been reproduced. Dibdin's reproduction in 1810 was "printed from a wooden block for the convenience of press work," and he copied but five of the "byrth fygures," viii to xii.

These famous figures were not original with Rösslin. There is no doubt of that. Manuscripts all over Europe contained a great many illustrations, from which pic-

tures in the early printed books were freely borrowed. These came almost certainly



F1G. 5.

from Moschion's or Muscio's Latin "Catechismus for Midwives," and were taken by him from Soranos. In a scholarly discussion of the "Rosengarten," Ingerslev points out an analogy between Moschion's version of Soranos with Rösslin's text, and shows that the illustrated "Codex Palatinus" containing 16 illustrations of positions of the fetus was in Heidelberg close by, when Rösslin's book was published. Soranos, the first to draw the uterus, compared it to a cupping glass.

Who Muscio was is not quite clear, or when he lived, but probably in the sixth century; his manuscripts were widely distributed, and it is definitely known since

the epoch making discovery of the original work of Soranos in 1838 by Fr. Reinboldt Dietz, that Muscios' work was but taken

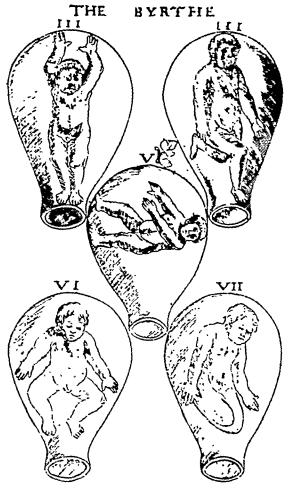


Fig. 6.

from Soranos, the Ephesian, who lived in Rome a short time before Galen.

The first plate bears the caption "Birth Fygures," the other three are called "The Byrthe Fygures," with these words as one heading extending across the top of the second and third plates.

The uterus in all the figures looks like a Florence flask, each with a child, twin, or monstrous pregnancy stretched out at full length with the arms over the head in almost every attitude of the gymnast. Fisher thought the ages of the fetus might be anywhere from one to ten years, but many look years older, with the faces of old

Proper illustrations from an anatomical it could be found in the great institutions of point of view are not found in medical learning, and it was not until the 19th

literature until Smellie in 1754, and century that the average midwife felt that

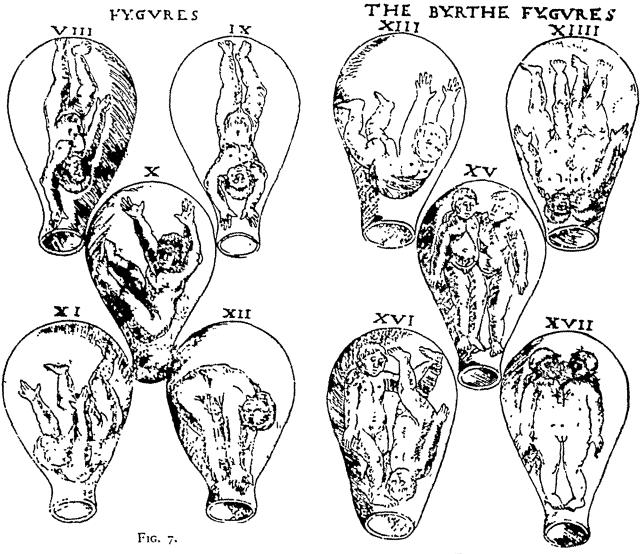


Fig. 8.

Figs. 5, 6, 7, and 8. The byrthy fygures and womans stowle, 1540 edition figures. Reproduced for the first time here. Possibly first copper plate impressions in England.

William Hunter in 1774, published their work.

THE BIRTH STOOL

The obstetrical chair, birth bench, birth stool, or woman's stowle of Rösslin is exactly like the chair of Soranos. It flourished in Greece and Rome, was well known to Soranos and Galen, and later to Aëtios, Aeginetes and Avicenna, apparently surviving best in Italy. Its modifications were numerous, and all sorts of mechanical contrivances were added to it, in the hope of assisting delivery. In the 17th century

she could do without it. In our own times we have seen attempts made to revive it. Mauriceau in the 17th century was the first to make routine use of the bed for delivery. Among primitive peoples the delivery posture was anything but lying down; they were delivered standing, suspended, sitting, squatting, kneeling, or semi-recumbent either on the lap of an assistant, in a chair, on the floor, or the ground.

The antiquity of the stool has interested many, and the famous chapter of Exodus has often been quoted. Pharaoh speaking to two midwives, said: "when ye do the

office of midwife to the Hebrew women, and see them upon the stools, if it be a son, then ye shall kill him . . . "

Engelmann was convinced that its antiquity had been vastly overrated, and he translated the ancient Hebrew word ebnaim in this passage, as stones not stools. Soranos however, describes the chair exactly as Rösslin pictured it, and speaks of it as being used by Herophilos. This is enough to assure us of its antiquity, as it was certainly known to the Alexandrian School. Rösslin's picture is the first found in the literature. "The midwyfes," he says "have stoles for the nonce, whiche beynge but lowe, and not hye from the grounde, he made so compasse wyse and cave or holowe in the middes that that mai be receaved from underneth which is looked for."

HISTORICAL RETROSPECT

The importance of this curious book is best estimated in terms of the "Rosengarten," which Fasbender calls a milestone in the history of midwifery. Purely a compilation, or review, containing nothing new, it simply collected material, from the ancient and medieval periods, Hippocrates and Galen to Avicenna and Albertus Magnus. It was written in a language understood by those whom it was intended to reach, the ignorant midwives of the time. Rösslin has been called the teacher of the midwives of Europe.

Although usually referred to as the first book on obstetrics, this is not quite true, as Ortolf of Bavaria had written a little book, without date or title, which never attained more than scant attention and little circulation. Rösslin's book however went into a hundred editions. Although he died in 1526, long before the publication of the English edition, he saw it translated into Dutch in 1516 and Bohemian in 1519. There were 28 Dutch translations up to 1742.

The book marked the renaissance of obstetrics which had languished for fourteen centuries. It was certainly the highest

authority on obstetrics in the 16th century. It accomplished only a little in the revival of the lost art of podalic version, for which Paré and his pupil Guillemeau did so much later. It was not until the latter part of the 17th century, however, by the teaching of Mauriceau especially, that this operation became an important obstetric procedure.

With the fall of empire in Egypt, Greece and finally Rome, the art of midwifery declined. The fairly well developed knowledge of those periods waned and was almost lost. Aëtios in the 6th century was the last to mention podalic version, a thousand years before Paré. A search of medieval literature yields but little worthy of note.

Modern medicine has its deepest and strongest root in the medical knowledge of ancient Greece, for Hippocrates in the 5th century before Christ, had elevated his art to a point which it did not reach again for six hundred years. In his time, although physicians assisted midwives, they were not highly regarded, but the midwives were recognized by law, and their duties clearly prescribed and understood. Such a condition did not occur again until 1555 in Ratisbon. About that time too a school for midwives was established at the Hôtel Dieu in Paris.

After the fall of Corinth in 146 B. c., their physicians deserted Greece for her stronger neighbor, Rome, where, at first unwelcome, they increased in influence and knowledge, until in the second century of the Christian era Soranos of Ephesus, a great physician, became the greatest obstetrician of antiquity. From his time until the publication of Rösslin's book, no progress was made. The obstetrical procedures of the Greeks were lost, and little more than mutilating operations were done upon the fetus.

Soranos himself did obstetrics, but with the next two hundred years, the physician as accoucheur passed so completely that his presence at a delivery not only was unwanted, but actually frowned upon by custom.

In Paré's time, the physician began to come into his own. Boucher later delivered La Vallière, the mistress of Louis xiv, and Clement in 1682 officiated at the birth of the Dauphin. He received the title of accoucheur, but the word man midwife persisted until the last century.

There is no evidence that Rösslin ever delivered a patient. Ingerslev thought he was no doubt a famous and able obstetrician, while Siebold believed that he had no practical knowledge of obstetrics whatever. At any rate in 1522 Dr. Wertt of Hamburg. disguised in woman's clothes in order to witness a delivery, was burned to death for his pains.

No picture of Rösslin can be found, but some idea of his appearance can be gained from the woodcut in his book, which shows him presenting his book to the Duchess of Brunswick, his patroness. Of his life and attainments, we know little more than that previous to his becoming city physician of Frankfort, he had been a doctor in Worms.

The curious title of his book is of interest. Haggard thinks that Rösslin, probably never having seen a child born, felt the humor of his position; the book was a "Garden of Roses for pregnant women and for midwives." Choulant connects it only with the name of the author, while Ingerslev thought a botanical title was selected because Germany from its earliest time was a fertile field for the sale of books of that sort.

All these things are of great interest, yet possibly of very little value except to those who are concerned with tracing the beginnings of our obstetric art.

I would like to include the entire book, but that is of course impossible. So few have seen it. Copies of Jonas' translation are not available, although it seems that its quaint language, old spelling, curious prescriptions and medieval advice would appeal to every one interested in obstetrics. A few excerpts follow:

Of deade byrthes . . . and by what meanes it may also be expelled . . . Fyrste without instrumentes with this fumigation: take other the hove or dunge of an asse, and put it on coles, and lette the woman receave the fume under-

neathe. Another: take the skynne of an adder. castoreum, brymstone, galbanum, oppoponcum, madder that the dyerres occupye, pygeons dunge, or hawkes dunge: beate all these to powder, and temper them with oxe gall, and make pylles of it each of the quantite of a fylbert nutte, and then put one after another in the coles, and receave the fume thorowe a pype or conduyte made for that purpose in to the privities.

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Fourteen other methods follow. On how to determine sex:

. . . but if ye be desirous to know whether the conception be man or woman: then lette a droppe of her mylke or twavne be mylked on a smoothe glasse, or a bryght knyfe, other elles on the nayle of one of her fyngers, and yf the mylke flew and spredde abrode upon it, by and by then is it a woman chylde: but yf the droppe of mylke contynue and stand styll uppon that, the whiche it is milked on, then it is a sygne of a man chylde. Item yf it be a male, then shall the woman with chylde be well coloured, and lyghte, her belly rounde, bygger towards the ryghte syde then the lefte, for alwayes the man chylde lyeth in the ryghte side, the woman in the lefte side.

Yf it chance that the woman in her labour dye, and the chylde hauving lyfe in it: then shall it be meete to kepe open the womans mouth, and also the nether places; so that the chylde by that means both receave and also expell ayre and breath, which otherwyse myght be stopped, to the destruction of the chylde.

I could not conclude without offering my earnest thanks to Mr. Charles Frankenberger, Librarian of the Medical Society of the County of Kings, whose enthusiastic, tireless help in research has been a great help to me.

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* Continued from page 90.

BOOK REVIEWS

AN INTRODUCTION TO GYNECOLOGY. C. Jeff Miller, M.D. St. Louis, C. V. Mosby Co., 1931.

Dr. Miller needs no introduction to the medical profession of this country. His accomplishments have been many; the honors bestowed upon him have been earned by years of endeavor.

The beginning of his preface is characteristic: "It is incumbent upon the author of a new textbook of gynecology, in view of the many excellent ones which already exist, to offer an explanation of his performance, if not an apology for it. In my own case, my teaching experience of more than twenty-five years has convinced me that the larger treatises on gynecology, scholarly and comprehensive though they be, do not answer the need of the beginning student for the reason that he lacks the ability to use them selectively." With that idea in mind Dr. Miller wrote an outline of gynecology for his students.

The book is composed of sixteen sections, amply illustrated, and covers the subject except that therapy is not considered. This, because the author considers "therapy must be based upon a comprehension of the disease to be treated and should be reserved until proper foundation has been laid."

Do not get the idea this work is of value only to undergraduate students. Any physician may well read and reread it with pleasure and profit.

THE COMMON SENSE OF DRINKING. By Richard R. Peabody. 191 pp., Boston, Little Brown, & Co., 1931.

The publisher's statement that "This is not an argument either for or against the Eighteenth Amendment, but rather, an acute and personal analysis" must be admitted to be borne out by the book itself.

In the Introduction, the author states that "For the more responsible concerns of life, a state of mind wherein the individual actually does not want to drink must be attained." The attainment of such an object would be a very desirable state of affairs. There is no doubt but that "The Common Sense of Drinking" is summed up in this statement.

Mr. Peabody, in 200 pages, makes a very good case for his theme. He offers in the way of remedy the application of common sense but, after all, applying that, we would not

have had the problem at all. Therefore in the race towards solving the problem, the solution seems to have been left at the post. However, there can be no question but that this book, if properly read and digested, will have a wholesome effect.

Written by a trained scientist, the problem is faced in a rational and logical manner rather than emotionally as is the case with most arguments on this question today. The "excuses" for drinking are knocked in the head, one after the other. The "necessity" for alcoholic stimulation would seem to be disproved and all of this without any preaching or dogmatism. A thorough study of this book and the application of its teaching would do more to solve our great national problem than all the constitutional amendments that might possibly be devised.

TABELLEN ZUR DOSIERUNG DER RONT-GENSTRAHLEN (Roentgen Ray Dosage). By Prof. Dr. L. Grebe, Director, Roentgen Institute, University of Bonn, and Dr. Phil. K. Nitzge, Bonn. With seven graphics. Supplement to Strablentherapie, Vol. XIV. Berlin, Urban and Schwarzenberg, 1931.

The authors do not purpose to present a textbook on radiation therapy, but rather to furnish a number of tables which will permit the more accurate employment of dosage in clinical radiation therapy. There is first a chapter on the measurements of roentgen rays and a discussion of roentgen ray absorption. The very important subject of scattered radiation is gone into carefully, as well as the relative depth dose for a given intensity of superficial radiation. The remainder of the book, comprising more than 150 pages, is devoted to tables relating to spark gap, half-value layers, filters, including paraffin, water, aluminum, copper, zinc, lead, and air, and different sizes of ports of entry (fields of radiation) from 400 sq. cm. down to 50 sq. cm. For those engaged in deep x-ray therapy, such a book of tables furnishes a mass of data of great importance.

Text Book of Physical Therapy. By William Benham Snow, M.D., Vol. 1, 708 pp., N. Y., Scientific Authors' Publishing Co., 1931.

This book is stamped "Vol. 1" on the backbone, but there is nothing to indicate either on the title page or elsewhere how many volumes there will be altogether.

The book before us is divided into three sections: (1) Direct Currents, Constant Current and Static Current—20 Chapters; (2) High-Frequency Currents—14 Chapters; (3) Electrosurgery—8 Chapters. It is avowedly a plea for physical therapy by one of the most enthusiastic adherents of this method of treatment.

The following paragraph at the beginning of the Introduction is indicative of the handling of the entire subject: "Physical therapy in its scope provides a means of correcting displacements by readjustment and supports, and in removing inflammatory exudates, which is not possible by drugs, surgery, or the other departments of therapy. The swelling occurring from the effects of trauma—the local stasis engorging affected parts of the organismresist all passive measures. The inflammatory exudates in neuritis, the swollen joints with arthritis, the congested glands internally, as of the liver, pancreas, spleen, or prostate, and any other part of the organism which may become engorged either from trauma caused by accident or the developments of infection which disturb the circulation and so impair the normal function of the parts involved or from other cause, likewise require a vis a tergo to relieve each condition. These disturbed conditions may be relieved sometimes by exercise, massage, mechanical vibration, or some form of radiant energy, but when not the seat of infection the static modalities will remove exudations in the early stages before fibrosis ensues." With such broad statements it is felt not many will agree.

The following quotation from the Preface further indicates the author's predilection for empiricism: "Clinical experience alone can furnish data broad enough to prepare the treatise now undertaken and clinical evidence will be considered as laboratory work, the same as in other medical investigations. A series of clinical studies in a class of similar cases, with established definite results, is the best clinical proof that can be given of the efficacy and indication for the employment of therapeutic measures or methods."

This book represents the school of physical therapists who feel the necessity for proving, to their own satisfaction at least, that their particular method or methods serve as a cure all for all the ills that flesh is heir to.

The credo of the rational physiotherapist is well expressed by Stewart in the Preface to his work on Physiotherapy¹: "It cannot be emphasized too strongly that the author does not consider physiotherapy as an end in itself but he feels rather that it is an invaluable adjunct to other methods of treatment, and is one which has not yet received its deserved recognition in scientific therapeutics." This seems to be too conservative for acceptance by the author of the formidable volume before us. There are numerous case reports almost invariably winding up with such statements as: "At the end of a week, he was completely relieved of his trouble." . . . "After the second treatment I maneuvered a readjustment. These treatments completely cured this case." . . . "Only two treatments were required for this case, when he was in a normal condition."

A rather startling statement is made in the report of a case of traumatic arthritis: "He was referred to—to have a hip splint made that would keep all weight off from the knee. When he went for the splint he asked the workman how long he would have to wear it. The reply was 'as long as he lived.' He paid for it, hung it in his closet, and came to the author for treatment."

It would be interesting to know in this case what the doctor who prescribed the splint thought of the "workman's" prognostication. There seems to be little if any follow-up to any of the cases. The fact that the patient left the author's office satisfied seems to be accepted as evidence of a cure.

Every form of physical therapy is here considered from gymnastics to radiology. The treatment in some form seems to be applied to practically all diseases running the entire gamut of functional and organic disorders. The sincere enthusiasm of the author appears on every page. Quotations are largely of his friends in the American Physiotherapy Association of which the author was president while it was still the American Electrotherapeutic Association.

Physical therapy is rapidly acquiring a high scientific status. It is with regret that we see a book of this kind published under a 1931 imprint. It had been hoped that Physical Therapy, as discussed in this work, was a thing of the past.

¹Stewart, H. E. Physiotherapy. Theory and Clinical Application. Ed. 2, N. Y., Hoeber, 1929.

PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

REGINALD A. CUTTING, M.A., PH.D., M.D., C.M.

PUBLISHED SERIALLY IN

The American Journal of Surgery

SEVENTH INSTALLMENT

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PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

CHAPTER X

URINARY DISTURBANCES

Urinary disturbances constitute a fairly important, because frequently encountered, group of postoperative complications. There occur (1) the group of malfunctions comprehended by the general term, "nephritis," (2) infections of the urinary tract, and (3) disturbances of urination as such.

I. NEPHRITIS

Nephritis does not, properly speaking, constitute a complication of operative procedures; at least, ordinary operations never produce the condition of nephritis in kidneys not previously the seat of degenerative changes. Furthermore, proceeding on the assumption that certain cases of nephritis are produced, or at least unfavorably affected, by focal infections, it has been customary for a number of years to remove foci of infection as a part of the treatment of nephritis, and when indications are believed to exist major operative procedures, like the removal of appendix, gall bladder, or infected Fallopian tubes, are undertaken without hesitation even in the presence of an established nephritis. In this connection Mosenthal1 states that "it is important to know that it is possible to operate in nephritic cases without fear provided such cases are not in a terminal stage; operative procedures apparently do not do any harm." Postoperative nephritis, therefore, represents merely a preexisting nephritis which may or may not have been influenced unfavorably by the surgical procedure. Inasmuch as such a nephritis constitutes essentially a medical rather than a surgical problem, no especial consideration need be given the matter in this treatise,

especially since such a discussion would involve an extensive digression.

II. INFECTIONS OF THE URINARY TRACT

Postoperative infections of the urinary tract include (1) infections of the bladder: cystitis, and (2) infections of the kidney and its pelvis: pyelitis, pyelonephritis, and pyonephrosis.

Postoperative cystitis occurs characteristically only in cases which have required postoperative catheterization, and accordingly the discussion of this particular urinary infection will not be attempted immediately but will be reserved for consideration in connection with postoperative retention of urine and catheterization.

- A. Pyelitis: The term pyelitis is used to designate any inflammatory process in the renal pelvis regardless of its etiology. Probably all cases of pyelitis are associated with a certain amount of inflammation of the kidney itself, a condition which collectively is designated as pyelonephritis in case the associated nephritis attains sufficient proportions. Pyelitis follows surgical operations in a small percentage of cases, 24 cases in a series of 7300 gynecological operations, or 0.33 per cent, according to Maloney and Cracco.²
- 1. Etiology: Undoubtedly many cases of postoperative pyelitis do not represent processes initiated during the postoperative period but, on the other hand, represent either acute or chronic processes which were overlooked at the time of the operative procedure. There is considerable evidence that pyelitis is not infrequently misdiagnosed appendicitis or cholecystitis, and the true source of the patient's symptoms becomes evident only after operative intervention has failed to provide the anticipated relief. Thus Van Dusen³ found that 7.6 per cent of a series of 300 routine cases of pyelitis had been subjected to appendectomy for the relief of symptoms which still persisted after operation and were relieved only by treatment for pyelitis, and that 9 per cent of his cases had similarly been subjected to surgery of the gall bladder for symptoms

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which persisted after the operation and were subsequently relieved only by treatment for pyelitis. The explanation of the development of idiopathic postoperative pyelitis seems to be that the trauma and shock incident to surgical intervention lower the general bodily resistance and thereby predispose to infections of all sorts, the development of pyelitis usually being purely incidental to this.

Pyelitis occurs about six times as frequently in the female as in the male, and accordingly may be regarded as practically a disease of females. The reason for the sex incidence seems to be in some way connected with the proximity of the ureters to the internal genital organs in the female; pregnancy and possibly even menstruation may be accompanied by sufficient congestive swelling of the urethers to narrow the lumen, cause temporary compensatory dilatation of the renal pelvis, and thus favor infection. In unilateral infections the right kidney pelvis is the one commonly affected.

The Bacillus coli communis is the organism most frequently found (between 75 and 90 per cent of the cases), but the Staphylococcus albus and the streptococcus are occasionally responsible for the infection. The focus of infection from which these organisms are derived undoubtedly varies, but the intestine must obviously be the ultimate source of the commonets invader, the B. coli; in this connection it has been found that the cecum and ascending colon have direct lymphatic connections with the right kidney, a condition which is not found to obtain on the left side, and very possibly this fact may account in some degree for the greater incidence of right-sided pyelitis. It is usually believed, however, that pyelitis frequently represents a blood-borne infection and in this connection must be considered the danger of liberating organisms into the blood stream during appendectomies, manipulation of a pyosalpinx the result of a mixed infection, and hemorrhoidectomies; also operative incisions about the rectum and perineum which latter must almost inevitably be contaminated by the colon bacillus. Kretschmer⁴ has called attention to the possibility

of chronic constipation as an etiological factor, 30 per cent of 200 cases collected by him having given a history of such a condition.

2. Symptoms: The most frequent symptom of pyelitis is pain. It occurs in about 70 per cent of cases and varies in severity from an occasional dull ache, either in the loin or along the course of the ureter, to a very severe stabbing pain like that seen in impaction of urinary calculi. Frequency of, and burning on, urination constitute the next most characteristic symptoms and are found at one or another stage in the course of the diseases in about 35 per cent of cases. Fever is present in only about 25 per cent, and urinary blood can be found in about 10 per cent of the cases. About 7 per cent of cases present no symptoms referable to the urinary tract at all (Van Dusen³).

The diagnosis is made, of course, on the finding of pus in the urine, and the degree of pyuria may vary from a few cells in a single microscopic field to macroscopic pus. Absence of pus from a sample of urine does not, however, necessarily eliminate a diagnosis of pyelitis, because the ureter leading from the affected kidney may have become temporarily blocked, and conversely the discovery of pus in a sample of urine does not necessarily indicate pyelitis unless the urine has been obtained by catheterization of a ureter, because pus may find its way into the urine not only from the kidney pelvis but from the urinary bladder, urethra, prostate and seminal vesicles, or from the external genitalia especially in females.

Clinically pyelitis may conveniently be classified in two types, (1) that in which the symptoms are confined to a dull ache in the loin and pus in the urine, and (2) that in which there is a fever of 100°F. or more, in which the pain in the loin is more acute and persistent, and there are symptoms of dysuria. Inasmuch as inflammation when confined to a mucous surface is never responsible for severe systemic reactions the more acute cases invariably present some complication, Book Page 364

such as a metastatic abscess of the cortex of the kidney or secondary infection in a preexisting hydronephrosis.⁵

- 3. Diagnosis: Although pyelitis may be suspected when pus and organisms are found in the urine, the diagnosis can be made with certainty only after cystoscopy and ureteral catheterization, for the reasons previously mentioned. On cystoscopy the characteristic finding in pyelitis is a moderate cystitis most evident about the ureteral opening of the affected side, the ureteral orifice itself being hyperemic and swollen and the urine issuing from it being cloudy. Separate catheterization of the uterers and subsequent cytological and bacterial examination of the urine delivered from each serves to differentiate monolateral from bilateral pyelitis.
- 4. Treatment: In postoperative pyelitis conservative treatment usually suffices to affect a cure, and the time required usually does not exceed three weeks. Conservative treatment consists of (1) rest in bed, (2) stimulation of the emunctories, by gentle purgation in the case of the bowel, especially by mineral water, diaphoresis in the case of the skin, and forcing fluid in the case of the kidneys, (3) the use of urinary antiseptics, hexamethylenamine and sodium acid phosphate or salol, or possibly some of the newer drugs like hexylresorcinol, either alone or in alternation with alkali therapy, though these have by no means been universally used with success, and (4) the eradication of foci of infection as rapidly as the skill of the medical attendant and the condition of the patient permit. Undoubtedly the most important factors in the treatment are the enforcement of rest in bed and the physiological lavage of the renal pelvis which results from ingestion and subsequent elimination of large quantities of water. Under conservative therapy by far the larger percentage of cases of postoperative pyelitis undergo spontaneous resolution.

If at the end of three weeks the infection has not subsided, or previously to this in cases which do not make satisfactory progress as shown by frequently repeated examinations of the urine and subsidence of symptoms, the advisability of adopting more radical therapy should be considered, cystoscopic treatment.

Cystoscopic treatment consists in ureteral catheterization either alone or reinforced by subsequent lavage of the pelvis of the kidney. This form of treatment is indicated especially in those cases which present evidence of ureteral obstruction. The commonest manifestations of such obstruction are septic states characterized by recurrent chills and attacks of high fever, extreme prostration, and the development of palpable masses in the renal areas.

Pelvic lavage consists of introducing the ureteral catheter into the pelvis of the kidney and irrigating through the ureteral catheter with warm physiological salt solution until the solution returns quite clear. Instillation of 1 per cent silver nitrate solution to the capacity of the structure is frequently performed as an additional measure before the catheter is removed; this latter solution is left in situ. Lavage is usually repeated once or twice a week for several weeks. If this treatment proves unsuccessful twenty-four-hour continuous drainage of the ureters may be instituted, lavage and instillation of silver nitrate solution being performed at least twice during each twenty-four-hour period of continuous drainage.

Cases of postoperative pyelitis which do not respond favorably to simple conservative treatment should, of course, be placed in the hands of a competent genitourinary surgeon, and for this reason the discussion of specialized forms of treatment for pyelitis is merely summarized in this discussion.

B. Pyelonephritis and Pyonephrosis: Pyelonephritis and pyonephrosis are, of course, conditions of the utmost importance to the genitourinary surgeon, but are of relatively little importance as postoperative complications because they occur uncommonly in the practice of general surgery. Both of these conditions, however, may represent merely the further progress of a simple pyelitis and consequently merit brief discussion.

In pyclonephritis there occurs concurrent infection of both the pelvis of the kidney and the kidney itself. The differentiating feature between a simple pyclonephritis and a pyonephrosis is entirely clinical and depends upon the fact that in the former no interference with kidney function can be determined, whereas in the latter by the use of the familiar dye-excretion tests the function of the affected kidney may be shown to be diminished. The method of estimating kidney function by the use of dyes is sometimes designated as chromocystoscopy.

Pyelonephritis may occur in three clinical forms:

- (a) The more common or mild form which differs in no essential particulars from moderately severe simple pyelitis. The patient, however, usually exhibits more pronounced symptoms of toxemia, micturition is commonly frequent and painful, and definite attacks of polyuria tend to occur. The urine contains pus and frequently blood.
- (b) The ordinary acute form, which is characterized by a still more profound systemic reaction, pyrexia, headache, anorexia, alternating attacks of constipation and diarrhea, and pain and tenderness in the loin, together with pyuria and reflex bladder symptoms, as in the former variety, and
- (c) The fulminating form in which there is an acute onset with definite rigors, pyrexia to 104°F., vomiting, diarrhea, acute pain in the loin, and subsequently delirium. In these cases little urine is evacuated, and such as is voided contains blood, albumin, and pus. Death commonly ensues within a week regardless of the treatment employed.

Pyonephrosis represents a condition in which considerable gross and microscopic destruction of the renal parenchyma is occurring or has occurred. In the severest forms little remains of the kidney or its pelvis except a connective tissue envelope containing pus. Except in those cases in which blockage of the ureter occurs the symptoms of pyonephrosis may be exactly the same as those of pyelonephritis; indeed, the dividing line between the two conditions cannot be drawn clinically. Obstruction to the ureter produces a rapid exaltation of

virulence of the bacteria present, and sudden high fever and severe renal pain soon follow; the area over the kidney may become very tender and the kidney itself may become palpably enlarged.

Pyonephrosis represents a degeneration of kidney substance so extensive that usually when monolateral the best treatment is nephrectomy, providing the function of the remaining kidney is deemed sufficient to warrant such a procedure; nephrectomy may also be advisable even in the more severe varieties of pyelonephritis. Otherwise the treatment of these two conditions as postoperative complications is largely prophylactic and accordingly the same as that for simple pyelitis.

III. DISTURBANCES OF URINATION

Under the heading of "disturbances of urination" is considered that subdivision of urinary complications in which the mechanics either of the formation of urine or of its subsequent passage from the kidney along the excretory system to the external urinary meatus is deranged so that none, or at least only a part, of the normal quantity of urine, is discharged. This implies that such urine as is formed is normal in character. Diminished output of urine is, of course, encountered both in infections of the urinary tract and in nephritis at times, but such a diminution of urinary output is not primarily of mechanical origin, and the urine which is discharged is characteristically found modified in accordance with the nature of the particular infection or renal change present.

This use of the term "urination" probably does some violence to the most commonly accepted sense of the word. By "urination" one usually means the relaxation of the internal and external urethral sphincters and the discharge from the body by vesical muscular contraction of urine previously contained within the urinary bladder. However, as Rehfisch⁶ in 1895 showed, the internal sphincter alone is capable of adequately performing the function usually per-

formed by both sphincters; and as Young⁷ has shown, the reverse is also true, the external sphincter alone being adequate to control urinary evacuation. When both sphincters, moreover, are paralyzed or otherwise incapacitated the urinary dribbling from the urethra is also called urination, although such urination is usually qualified by the term "involuntary." Urination, therefore, may occur quite in the absence of the function of both sphincters; in such cases muscular contraction of the bladder is unnecessary because the bladder no longer functions as a reservoir.

Thus the term "urination" is still used when the so-called "act of urination" has ceased to be an act in any proper sense of the word at all. Furthermore, the generic sense of the word is merely the evacuation of urine, and as such evacuation is normally dependent upon the integrity of the kidney and ureter as well as that of the bladder and urethra no real violence is done to terminology when urination is used as a comprehensive term connoting the mechanical function of the entire urinary tract from kidney to external urinary meatus.

Failure of a patient to pass urine in normal amounts postoperatively may obviously be due (1) to failure of the kidneys to secrete, or (2) to mechanical obstruction to the passage of urine somewhere along the course of the excretory system, ureters, bladder, or urethra.

A. THE CLINICAL TERMINOLOGY, "ANURIA, OLIGURIA, RETENTION, SUPPRESSION": The urinary tract has been so generally divided for purposes of anatomical and clinical discussion into "upper" and "lower" portions that it is not surprising to find a corresponding dual division of the physiological terminology.

Etymologically "anuria" and "oliguria" should mean respectively the "situation in which no urine is passed from the body" and the "situation in which the quantity evacuated is less than the normal amount," but actually both of these terms as commonly used refer only to dysfunction of the upper urinary tract, viz., the kidney and ureter. Dysfunction of the bladder and urethra in the direction of diminished urinary output is designated "retention."

Thus when urine is normally delivered to the bladder, but because (a) of interference with the sensory stimulus to urination, (b) of interference with the contractile power of muscular elements in the wall of the bladder, or (c) of mechanical obstruction to the normal excretory duct of the organ, the urethra, the condition is said to be one of urinary "retention." When, on the other hand, whether due (a) to failure of the kidneys to secrete normally or (b) to obstruction to the passage through the ureter of urine already formed, a reduction in the amount of urine delivered to the bladder results, a condition of partial or complete "anuria" is said to exist. "Oliguria" is, of course, the condition of partial "anuria."

The distinction between the type of anuria or oliguria due to failure of the kidney to secrete and the type due to the failure of the ureter to excrete has been emphasized to a considerable extent in the past, and the two forms of dysfunction have been called respectively the "secretory" and the "excretory" types, or according to another terminology the "prerenal" and the "postrenal" types. It must be remembered, however, in using the terms "excretory" or "postrenal" in connection with anuria that these terms apply only to ureteral obstruction and not to the chain of urinary disturbances which may occur further down in the urinary tract; they are consequently equivalent to another term not infrequently used in this connection, "suppression."

- B. SECRETORY OR PRERENAL ANURIA:
- 1. Etiology: a. Reflex Anuria: There is some dispute as to whether pure reflex anuria ever occurs. A considerable number of authorities, among whom are Guyon, Israel, Albarran, Kummell, Hammesfahr, Neuwirt, and Fruchard-Brin, believe that reflex anuria is a distinct clinical entity. Keyes, Legueu, Rovsing, Casper, and Watson on the other hand believe that the condition of true anuria is so rare that they doubt its existence at all.

According to Neuwirt¹⁰ the reflex involves the nerves which contain the vasomotor supply to the kidneys and the splanchnic nerves. He says that division of the splanchnic nerves gives rise to a polyuria, whereas irritation of these nerves, such as would occur as the result of ligation of the pedicle of the opposite kidney, would tend to produce a vasoconstriction with resulting oliguria or anuria. In expansion of this theory Neuwirt suggests a method of treatment which consists of anesthetizing both splanchnic nerves (splanchnic anesthesia by the technique of Kappis) with a solution of novocaine, and he has been able to apply this therapy in one clinical case with startlingly good results.

Certainly true reflex anuria occurs, if at all, as a relatively rare condition, and in the absence of some factor not readily apparent it would seem well-nigh impossible to understand why it should occur so infrequently if it does indeed constitute an essential clinical entity. Anuria has been reported most commonly following operations involving the more serious kidney operations, such as nephrectomy and nephrotomy, and seems to occur especially in connection with such procedures as involve ligation of the kidney pedicle and ureter of the opposite side, but only a relatively small number of such procedures are complicated by anuria. Similarly, various intra-abdominal operations, such as appendectomies and operations on the biliary tract, have occasionally presented this complication, but the percentage of such cases is so low as to be almost negligible. Many authorities of large operative experience who have had the opportunity of following a considerable number of cases to autopsy are inclined to believe that a great proportion of the cases of so-called reflex anuria are really dependent upon actual degenerative processes in the kidney, such as acute or chronic inflammatory changes, hydronephrosis, the presence of calculi, and renal tuberculosis.

Clairmont and Von Heberer, 11 and Staheli 12 have reported cases associated with gall-bladder surgery, and the last-named

author believes that a definite correlation in function between the liver and kidney exists such that disease of the liver, especially disease associated with icterus, is commonly associated with parenchymatous nephritis. He suggests that these changes are characterized by the presence in the circulation of bile acids, bile pigment, or other toxic products which have been formed as the result of impaired hepatic function and have failed to be properly excreted by the kidney. If this conception of anuria be correct the treatment of the condition would be largely prophylactic, would consist of careful determination of kidney function preoperatively, and in cases of doubt cystoscopic examination and catheterization of the ureters to make sure of their patency.

Probably in most cases at least, the condition represents merely the response of a kidney previously damaged to an extent such that it is unable to cope with the additional load placed upon it by the operative procedure or by the immediate effects thereof. This is essentially the teaching most commonly adopted even by the proponents of the theory of true secretory anuria, as they are inclined to admit that only a kidney previously diseased is subject to the reflex influences producing reflex suppression. It must be added, however, that instances of reflex anuria have apparently followed nephrectomies even in cases in which previous cystoscopic examination had shown that the kidney removed was practically without function, whereas the other functioned in a manner sufficient to care for the ordinary needs of the organism.

Patients exhibiting this complication usually present symptoms of slight drowsiness but no alternation of consciousness; headaches are unusual, and respiration and pulse rate are often relatively normal. In fact, the patient frequently shows no physical signs suggestive of the existence of a condition of perverted excretory function. Under these conditions, however, the urea concentration may be of the order of magnitude of 400 mg. and that of creatinine of the order of magnitude of 13.5 mg. per 100 c.c. of blood.

The prognosis is usually essentially the same as that in cases of acute nephrosis, such as is seen in bichloride of mercury poisoning. Many of them recover satisfactory, or normal, function within the course of a few days.

Therapeutically little can be done for such cases beyond the administration of a low protein and salt-free diet and the administration of from 2500 to 3000 c.c. of fluid daily, which amount can frequently be administered per os.

b. Secretory Anuria Secondary to Low Blood-Pressure: There is certainly one type of anuria which can be classified as secretory and which is not reflex in the formerly applied sense of the term, the anuria secondary to low blood-pressure. Physiologists have shown that failure of urinary secretion may be expected to occur in normal individuals whenever the bloodpressure in the renal artery decreases below about 40 mm. of mercury pressure. In patients, subjects of hyperpiesis, in whom the kidneys have become accustomed to higher blood pressures than normal an even greater blood-pressure than this may be inadequate to maintain urinary secretion. Failure of urinary secretion in patients in shock is thus explained and probably also those cases in which the sudden withdrawal of urine from cases with prostatic obstruction is followed by anuria, for it has been shown by O'Conor and others13 that the resultant sudden decompression of the kidneys is characteristically followed by a marked fall in the systemic blood pressure sufficient to induce the type of suppression under discussion.

c. Secretory Anuria Secondary to Blood Concentration: There can be no doubt in the light of some of the more recent researches in connection especially with the pathology of burns and intestinal obstruction, that a condition of extreme concentration of the blood is inconsistent with urinary secretion. Complete suppression of secretion is not particularly common from this cause, it is true, but the possibility of such an occurrence should be remembered, and the medical attendant

should be especially on his guard against the development of the less severe grades of such a condition.

2. Treatment: The preceding account of the secretory anurias, admittedly fragmentary and incomplete in the present state of our knowledge, justifies little dogmatization with respect to active therapy beyond the fairly obvious indications for restoration of normal blood-pressure levels in cases secondary to low blood-pressure or dilution of blood concentration.

The treatment of secretory anuria of reflex origin especially, and that of the last mentioned types to a lesser extent, is fundamentally prophylatic. Reflex anuria in the healthy kidney being virtually unknown, the indications are for a very careful and accurate survey of the condition of the kidneys preoperatively in all surgical cases, but especially in those of the more severe kidney operations and those in which dependence must be placed postoperatively upon the function of a single kidney. Measurements of kidney function by any single method are unsatisfactory for this purpose: a combination of all methods is highly desirable, especially the "Mosenthal," the "dye-excretion," and the "urea-concentration" tests.

In the presence of an established case various alternatives have been suggested one or another of which may prove successful in some cases, whereas a combination of all of them may be ineffective in others. Perhaps the best single form of therapy is intravenous infusion of dextrose; a large quantity, 750 to 1000 c.c. of a 5 per cent solution may be tried, and a repetition of the dose should be made as often as may be deemed advisable in case the first infusion or subsequent infusions are unsuccessful.

Reestablishment of urinary secretion has also been reported following catheterization of the ureters. As a last resort, and usually ineffective, the capsular stripping operation of Edebols may be tried, but the latter probably offers very little prospect of success.

c. Postrenal or Excretory Anuria and Oliguria: Any condition which occludes the lumen of the ureters will give rise

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to the development of a condition of postrenal or excretory anuria. Frequently the obstruction is temporary and incomplete but it may be both complete and permanent; the latter condition is, of course, inconsistent with life.

1. Periureteral edema, Extra-Ureteral Tumors, Section of the Ureter: a. Etiology: Perhaps the most frequent cause of postrenal anuria is the edema which follows operative manipulations upon, or trauma in the region of, the ureter. Operations upon the organs of the female pelvis, especially the performance of hysterectomy and salpingectomy, because of their involvement of manipulations in the immediate region of the terminal portions of the ureters are particularly likely to be followed by partial and temporary ureteral occlusion, and this is particularly true of the operation of extensive anterior colporrhaphy, following which there is characteristically a marked edema of the vesical wall which tends to occlude the intravesical portion of the ureters. It is not at all unusual for a greatly diminished urinary output to be noticed for the first twenty-four to forty-eight hours following such an operation. That this is the abnormality responsible in such cases can be demonstrated by cystoscopic examination and an attempt to catheterize the ureters.

Carcinoma of the cervix, prolapsus uteri, and tumors and tumefactions in the broad ligaments may not infrequently lead to excretory anuria and the production of a bilateral hydroureter as the result of a simple pressure effect.

The inclusion of one or both of the ureters in a ligature, or, less frequently, the complete severance of the ureter during the course of an operation is not a particularly rare operative event especially at the hands of the unseasoned surgeon.

b. Treatment: The treatment of such complications as have just been detailed is largely prophylactic, as will readily be appreciated from a consideration of the pathology. Gentle handling of the tissues in the region of the ureters is of the utmost importance in avoiding undue postoperative edema.

2. Calculus Anuria: Calculus anuria represents a condition in which urinary calculi previously present but giving rise to no symptoms are dislodged and eventually block the ureter. The condition is encountered very unusually as a postoperative complication although a considerable number of cases have found their way into the literature at various times. As early as 1895 Legueu¹⁴ was able to report a series of 86 cases, and Morris, ¹⁵ in 1901, presented an analysis of 104 cases.

Blockage of only one ureter in the aforementioned manner would, of course, result seriously only in case the function of the opposite kidney was unduly disturbed; such would be the case

(a) in congenital absence or operative removal of the opposite kidney,

(b) in complete or virtually complete destruction of the opposite kidney by disease,

(c) in the condition of reflex anuria of the opposite organ, and

(d) in the condition of double calculus impaction.

Urinary calculi occur bilaterally in about 20 per cent of all cases; i.e., in approximately 1 case in 5, a consideration which indicates that the possibility of a bilateral calculus anuria is not altogether fanciful.

- a. Symptoms: In experimental animals simultaneous complete occlusion of both ureters causes death in from four to five days, but clinically, complete anuria frequently does not result fatally for from one to three weeks or more. Caulk¹6 classifies the symptoms in three stages: (a) premonitory, (b) tolerant, (c) uremic.
- (a) Premonitory Stage: The onset of calculus impaction may be marked by the occurrence of typical colicky pains in the affected loin with a tendency for the pain to radiate toward the iliac fossa, toward the external genitalia, and down the inside of the thigh, classical "renal colic." In other cases there may be simply a dull ache in the region of the affected kidney in the absence of acute symptoms. In a certain number of cases there

may be no symptoms at all to indicate the onset of the condition or to indicate the side affected.

- (b) Tolerant Stage: In the tolerant stage patients present no symptoms save that of anuria. On the passing of a catheter no urine is obtainable from the bladder, or at least only a very small amount, though the patient feels perfectly well. Sometimes the anuria is not constant, periods of complete anuria alternate with the voiding of large quantities of urine, the latter occurrence giving the medical attendant and the patient temporary and false relief from anxiety.
- (c) Uremic Stage: In those cases in which infection is superimposed upon the condition of calculus impaction and anuria, the course of the condition is apt to be fulminant; patients present the symptoms and signs of acute nephritis seen in bichloride of mercury poisoning; the temperature is elevated, and early toxemia is an important and early development. In other cases the effects of the anuria are very insidious. Except for the blood chemistry findings there may be no evidence in the early stages of the condition of the suddenly developing and rapidly fatal uremia that is impending. Of this stage Keyes¹⁷ says, "The patient seems well, eats and sleeps as usual, the pain has passed and discomforts are insignificant, and all the while there is brewing within him a crisis swift and terrible." Non-protein nitrogen figures as high as 150 mg. to the 100 c.c. of blood may be obtained during this period. Eventually the patient suddenly develops a condition of uremia and rapidly succumbs.
- b. Diagnosis: The diagnosis of the condition is made by positive radiographic findings in the presence of anuria, but negative findings by radiographic methods do not eliminate the condition from consideration because (a) not all calculi are opaque to the x-rays, and (b) disease of the opposite kidney in the presence of a monolateral calculus could not thus be demonstrated. In doubtful cases the ureter or ureters should be catheterized.

c. Treatment: Prophylactically the treatment resolves itself into very careful determinations of the function of the opposite kidney prior to the removal of one of these organs and the recognition of calculi preoperatively in cases in which the symptomatology is suggestive of such a condition. The treatment after anuria has become established is never expectant; under such treatment there is approximately an 80 per cent mortality. The exhibition of atropine and benzyl benzoate or the administration of splanchnic anesthesia may be tried in the earliest stages in an attempt to produce relaxation of the ureters and to favor the passage of the impacted calculus, but temporization with such methods should not consume much time if it proves ineffective.

Cystoscopic manipulations and the introduction of a wax-tipped ureteral sound into the affected ureter offers the best prospect for relief. By this means the stone may be dislodged and passed or may be pushed back into the pelvis of the kidney and thus a subsequent resumption of kidney function may be vouchsafed. In the event of failure of such manipulations formal operative procedures should be invoked, pyelotomy or ureterotomy. Surgery is indicated early in all cases, certainly before the fourth day, and the natural history of the development of the condition should be clearly recalled to mind lest the apparent excellent condition of the patient be considered sufficient grounds for delay and the golden opportunity for surgical interference be allowed to pass unimproved. The mortality rate in the use of this kind of treatment should be comparatively low; Caulk¹⁶ reported a series of 6 cases without a death.

D. Postoperative Retention of Urine: The term "retention of urine" is a somewhat unfortunate one inasmuch as within limits the retaining of urine is a normal function of the bladder, retention becoming abnormal only when unduly prolonged or exaggerated. The term has been so frequently used, however, in the sense of abnormal retention that misunderstandings from this source probably do not often arise.

Even though the bladder contains considerable urine patients frequently void with difficulty and only after relatively long periods of time following many operations, especially those performed under a general inhalation anesthetic and particularly after gynecological or rectal operations. The time limit beyond which failure to void becomes abnormal cannot be stated dogmatically since it depends, among other factors, on (1) the length of time elapsing between preoperative catheterization and the actual performance of the operation, (2) upon the extent to which the bladder was emptied at the time of this catheterization, (3) upon the duration of the operation itself, and (4) also upon the amount of fluid supplied to the patient immediately before or subsequent to that time.

1. Failure to Void as a Result of Atony of the Urinary Bladder: Ordinarily a patient who has been thoroughly catheterized just prior to operation can safely be allowed to remain undisturbed for a period of from eight to twelve hours following operation. At the end of this time, however, if spontaneous urination has not yet occurred an attempt should be made to determine the degree of distension of the bladder. Normally the bladder is, of course, a pelvic viscus, but when considerably distended it rises out of the pelvis and becomes an abdominal organ; in full distension the fundus of the bladder constitutes an ovoid tumor above the symphysis pubis the outlines of which may be determined by palpation and percussion, and in thin patients may be visually evident because of pressure exerted on the anterior abdominal wall. If on inspection, palpation, and percussion, the bladder is determined to be still within the pelvis at the end of from eight to twelve hours, no anxiety need be felt; if, on the other hand, one cannot be certain after careful examination that the bladder is not distended, or more especially if the fundus of the organ can be recognized well above the symphysis the question immediately arises as to the best means of inducing evacuation.

There is universal agreement among surgeons that spontaneous micturition should be induced if at all possible,

and there are certain rather classical measures which may and should be tried in an attempt to induce voluntary urination. The most valuable of these are the following: (1) placing of a hot water bottle or hot stupes over the bladder region, (2) douching of the external genitalia with warm water, (3) the administration, in selected cases, of a small hot enema (4 oz. at a temperature of 112°F.), (4) frequent changes of the patient's position in bed, (5) allowing the patient to hear the sound of running water, and possibly two other measures of doubtful value, (6) the intravenous injection of 5 c.c. of a sterile 40 per cent of urotropine, and (7) subcutaneous injections of pituitrin or casseine-sodio-benzoate.

If after the expenditure of a reasonable amount of effort in the trial of these various measures spontaneous voiding does not occur there are two remaining plans of action either of which may be adopted: (a) the patient may be left undisturbed until such time as the pressure of accumulating urine within the bladder becomes so great as to overcome the natural resistance of the sphincters, or (b) catheterization may be performed immediately and may be repeated again and again thereafter as often as the bladder becomes distended until spontaneous action of the lower part of the urinary apparatus is resumed.

The fundamental objection to the immediate use of the catheter in the relief of postoperative urinary retention is the danger of infecting the bladder and secondarily the ureters and pelvis of the kidney, the danger of "catheter cystitis and pyelonephritis." Ordinarily the danger of inducing such complications postoperatively is probably not great when catheterization is performed with good aseptic technique, because the normal bladder is remarkably resistant to infection. Experimentally it has been determined over and over again in the lower animals that the injection of considerable quantities of virulent bacteria into the bladder does not produce cystitis unless the bladder itself is traumatized or unless it is already the seat of degenerative changes, and in human beings the

relative infrequency with which cystitis follows cystoscopy is further evidence of the natural resistance of the bladder to infection. Cystitis and pyelonephritis are, however, exceedingly disconcerting, even dangerous, and in certain cases fatal, postoperative complications, and there is probably no sure way of determining whether a given patient's bladder is, or is not, normal and therefore as immune to infection as it should ordinarily be. Accordingly, many believe with Willy Meyer¹⁸ that urinary retention may well be allowed to persist unrelieved for thirty or even thirty-six hours before an attempt is made to force spontaneous voiding, especially in the male. This author cannot believe that the procedure does the patient any harm, though he does not advocate causing the patient an undue amount of suffering.

This conservative method is believed by many to be particularly applicable to those special cases in which retention is due to nerve lesions and in connection with traumatic injuries of the spinal cord such as are caused by fractures of the spine and gunshot injuries involving the cord either directly or by transmitted pressure. Thus Besley¹⁹ and Cumming²⁰ advocate avoidance of the catheter insofar as possible in all cases in which urinary retention is due to spinal cord injuries; the former believes that in such cases the catheter should never be used, and the latter, although he is inclined to believe that definite injury is caused the kidney by this procedure, feels that this damage is not sufficient to contraindicate forcing the development of retention with overflow.

It probably is true that the amount of distention of the bladder and the degree of back pressure transmitted to the ureters and kidney in the adoption of the procedure under discussion are in the average postoperative case incapable of producing permanent damage to the urinary apparatus, and the method is therefore probably relatively devoid of danger; on the other hand, a considerable amount of suffering is undoubtedly engendered in many patients by such methods, and this probably constitutes the fundamental objection.

Furthermore, there is some evidence that a prolongation of the condition of retention with overflow produces definite deleterious organic changes. Thus Curtis²¹ has shown experimentally that following paralysis of the bladder by division of the nervous control in rabbits cystitis developed in considerably more than half the cases, and that definite lesions in the upper urinary tract characteristically developed, distention of the ureters, nephritis, cellular infiltration of both cortex and medulla, renal hemorrhages, dilatation of the renal tubules, and occasionally extensive destruction of the kidney substance.

It is therefore probably better, providing the surgeon commands an intelligent and well trained nursing staff, to adopt the second alternative and to have patients eatheterized either at the end of a definite number of hours, usually from eight to ten, or in case interne supervision is particularly good, after a variable period of time, viz., as soon as the patient complains of discomfort or bladder distention becomes recognizable. There is some evidence for believing that routine catheterization of patients who do not void after a certain definite number of hours is intrinsically much less desirable than the institution of catheterization in accordance with the indications of discomfort and physical evidences of distention.

Curtis²¹ has observed that patients who require repeated catheterization postoperatively do not promptly regain the power to evacuate the bladder completely and that the presence of residual urine predisposes to cystitis. In order to determine the possible influence of the incompletely evacuated bladder on the development of cystitis and pyclitis, he studied the postoperative histories of a series of 1595 female patients who had been subjected to important surgical operations.

One thousand and fifty-one of these patients, or 66 per cent, required no postoperative catheterization. Of the remaining 544 patients who were catheterized, 11 per cent required artificial evacuation of the bladder once, 5 per cent required the procedure twice, and 17 per cent required three or more Book Page 382

catheterizations. Among the 187 patients, or 11 per cent, who required but one catheterization there were no cases which developed cystitis, but residual urine was detected in 6 per cent for a period of time not exceeding two days. Of the 88 patients, or 5 per cent, who required two catheterizations, 27 per cent showed residual urine thereafter; slight infection occurred in a few cases but promptly disappeared. Of the 269 patients, or 17 per cent, who were repeatedly catheterized 6 per cent showed residual urine for from four to eight days. In these cases the amount of residual urine generally decreased progressively from day to day, vesical symptoms and urinary pus were usually noted for a day or two and then disappeared.

Because of these findings Curtis practices and recommends the avoidance of postoperative catheterization whenever possible, although he does not hesitate to catheterize patients who are really suffering as a result of distention. Curtis advises that whenever it becomes necessary to catheterize a patient once that patient be thereafter subjected to daily catheterizations until free from residual urine; according to this technique the catheter is passed just after each spontaneous voiding. In connection with these catheterizations Curtis²¹ advises (1) the use of a boiled catheter (2) cleansing the external genitalia with a weak solution of mercuric chloride, (3) the instillation of a few cubic centimeters of 0.125 per cent silver nitrate solution just before withdrawal of the catheter, and (4) the administration of hexamethylenamine prophylactically in all cases in which the catheter is used. Residual urine of not more than an ounce is considered normal unless it contains pus cells.

Rupture of the bladder does not, of course, occur as a result of distention unless the bladder wall has been previously weakened by disease, and accordingly the principal indication for the use of the catheter postoperatively is the relief of discomfort or pain. If, however, the attitude be adopted that distention is not to be allowed to progress to distention with overflow it would also seem irrational to allow any considerable

amount of distention to occur at all even in the absence of discomfort, otherwise nothing is gained. Accordingly deeply narcotized or unconscious patients should be given special attention and catheterized before any considerable amount of urine has accumulated. Patients requiring repeated catheterization are in any case best put on a regular eight-hour schedule.

Hugh Cabot²² believes that urine should not be allowed to collect in the bladder postoperatively in an amount exceeding 10 oz. He accordingly believes that instructions should be given to empty the bladder by catherterization at any time after twelve hours providing the patient's sensations are such as to lead the attendant to believe that this amount has been exceeded.

Although, as previously stated, the normal bladder is infected only with difficulty, carelessness in the performance of catheterization should not be encouraged on this account, but rather nurses and attendants should be constantly impressed with the seriousness of contamination in connection with this procedure and the necessity of developing and maintaining a scrupulously aseptic technique.

2. Treatment of Postoperative Cystitis: In the acute stage of cystitis attention should be directed toward relieving the symptoms of suprapubic distress and frequency and urgency of micturition; a combination of tincture of hyoscyamus and potassium citrate, about 15 grains of the former and 20 grains of the latter, usually furnishes the desired effect when given at intervals of from three to four hours. The diet should be simple and bland, and fluids should be forced. If this treatment does not rapidly give relief resort may be had to codeine or even morphine.

Locally efforts should be directed toward the institution of free drainage of the bladder. If the patient shows no retention of urine, catheterization should be performed once during each twenty-four hours, and before the catheter is withdrawn the bladder should be thoroughly irrigated with a mild anti-

septic solution, saturated boric acid solution being probably the vehicle of choice, although it is highly probable that the mere mechanical lavage of the organ is the important consideration, and the beneficial action of the antiseptic is inconsiderable or even nil. In case the patient shows residual urine catheterization should be repeated every six or eight hours, and lavage should be performed subsequent to each catheterization as just described.

Postoperative cystitis rapidly responds in almost all cases to this form of treatment. As soon as the acute symptoms of the condition have subsided it is customary to prescribe hexamethylenamine and sodium phosphate, but probably forcing of fluid is of much more importance than drug therapy. In cases which do not respond to the treatment as outlined, infection of the upper urinary tract should be suspected.

3. Catheterization: Catheters are sterilized by boiling. Catheterization proceeds as follows:

In the case of the female, after the hands have been thoroughly scrubbed, the thumb and index finger of the left hand are used to spread the labia, and the vulva is carefully cleansed, first with soap and water applied by means of a sponge held in forceps and then by means of bichloride of mercury or lysol solution, particular care being taken to cleanse all creases. This may be done most conveniently over a bed pan. The right hand, which previously has come in contact only with the handle of the sterile forceps, is now plunged into the antiseptic solution and then picks up the catheter and introduces it gently into the bladder without allowing it to touch anything but the lining of the urethra.

In the case of the male, the procedure is essentially the same; the thumb and forefinger of the left hand hold back the prepuce while the right is used, first to cleanse the glans and fore skin and later to introduce the catheter.

Catheters pass much more easily if they are suitably lubricated at the tip with sterile lubricating jelly before being introduced. It should be remembered also, of course, that the urethra of the female is very short (4 cm.), whereas that the male is relatively long (17.5 to 20 cm.).

Not infrequently a patient who has once required catheter-

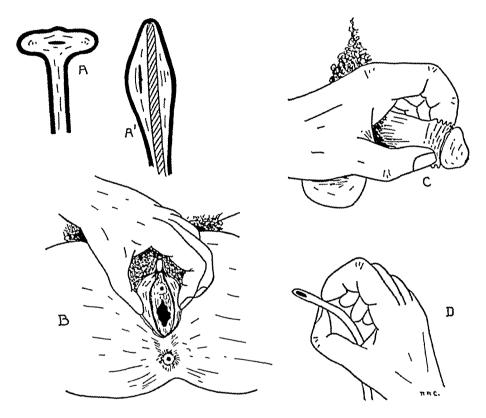


Fig. 47. Some of the essential features of postoperative catheterization. Inserts A and A' represent cross-sections of a Pezzer catheter, the former with tip of instrument in normal position, latter with mushroom tip stretched and elongated by metal probe passed through instrument from its open end ready for insertion into urethra of female.

Insert B represents proper method of spreading labia in female; this position should be maintained both during preliminary sterilization or cleansing of external genitalia and during actual introduction of catheter.

Insert p illustrates proper method of holding soft rubber catheter between thumb and index finger during introduction of instrument into urethra of either sex.

Insert c illustrates proper method of holding penis of male during processes both of cleansing glans penis and actual introduction of catheter.

ization requires it repeatedly, and much can be done to avoid such a circumstance by instilling into the bladder after catheterization an ounce of sterile glycerine, as suggested by the

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late Dr. A. J. Ochsner; this sometimes is of the utmost value in provoking spontaneous voiding subsequently. The instillation of an ounce of 1 per cent silver nitrate solution or an equal amount of 20 per cent argyrol solution at the end of catheterization is an excellent method of prophylaxis against subsequent infection.

In some instances patients who have required several catherizations postoperatively begin to void spontaneously thereafter, and it is accordingly assumed that all is well. Fever and symptoms of frequency and urgency may, however, continue if previously present or may be experienced for the first time if previously absent, and on physical examination the urine may be found to contain pus. In such cases introduction of a catheter will usually discover a large quantity of urine in the bladder, and the explanation becomes apparent: the bladder has been allowed to become unwittingly distended, and the voiding which was judged to be a normal resumption of function actually represented distention with overflow; the overdistended bladder has become devitalized, and cystitis has developed. For this reason, in cases in which peristent difficulty is experienced in emptying the bladder postoperatively it sometimes becomes advisable to make use of the indwelling catheter.

In the female a Pezzer self-retaining catheter is used. The technique of introduction is similar to that used in simple catheterization with the single exception that the catheter must be introduced on a probe, the probe serving the function of stretching the mushroom tip on the end of the rubber tube and thus allowing the manipulation to be made without undue trauma to the urethra (Fig. 47). Before leaving the patient one should ascertain that the catheter is functioning properly; to make sure of this gentle traction is exerted until the button-shaped end has been drawn down into the neck of the bladder. A syringe full of sterile water is then injected into the bladder and it should immediately be discharged from the catheter as soon as the syringe has been disconnected.

In the male a Pezzer catheter should not be used because of the inevitable trauma that would be inflicted during the insertion of such a device; a plain soft rubber or Coudé catheter is preferred in this case.

Postoperative catheterization of patients is usually found necessary in from 12 to 15 per cent of cases. Women require this procedure much more frequently than men, and married women require it more than twice as frequently as single women; consequently, catheterization is much more frequent in gynecological services than elsewhere. Doubtless a condition of relaxed perineum is often responsible for the necessity of catheterization, a condition which is usually associated with chronic vesical distention and which is manifested clinically by a cystocele; thus urinary retention in parous women is frequently the result of degenerative changes in the bladder wall. In nulliparous women urinary retention is frequently of neurotic origin.

Catheterization is required much more frequently in both sexes in connection with those operations involving the pelvic structures or operations upon organs in relation with pelvic organs, such as the appendix, than in other cases, and the incidence decreases markedly for operations on the middle and upper portions of the abdomen. Naturally, as previously stated, packing and other mechanical contrivances used in connection with pelvic surgery are frequently factors in predisposing to the retention of urine, but even in the absence of such mechanical factors urinary retention is more frequent in connection with pelvic surgery than in any other variety. The condition of shock favors urinary retention, as does any condition which depresses the blood pressure and favors a consequent decreased output of concentrated urine. Furthermore, the incidence of retention is greater in those operations accompanied by considerable pain, nausea, and vomiting.

Almost all patients find it difficult and many find it virtually impossible to void in the recumbent position. Many of these will need catheterization as long as they are required to

lie down, and the surgeon is wise who in such cases encourages early spontaneous micturition by having the patient lifted to the sitting position on the edge of the bed or to a standing position if necessary as early as the nature of the operation will permit, and this may be within a day or two in the case of many abdominal operations.

4. Failure to Void as the Result of Urethral Obstruction: In the absence of preoperative abnormalities which an adequate preoperative preparation could scarcely fail to reveal, failure of urination as the result of mechanical obstruction to the urethra must obviously be directly dependent upon operative procedures themselves, and as such are usually recognized without difficulty. Such a complication may obviously be expected, particularly in connection with operations involving the urethra, the rectum, the prostate in the male, and the vaging and uterus in the female. Occasionally the cause will be found to be a purely mechanical one such as pressure exerted by an unduly tight packing of the vagina or rectum; sometimes it will be due to the pressure of edema either resulting from direct trauma, or trauma which, exerted primarily outside the urethra, nevertheless spreads to the latter. At all events the condition is easily differentiated from the other causes of failure of urination by the passage of a catheter which on the one hand may become arrested at the site of obstruction, or, on the other hand, overcoming it and progressing into the bladder, will discover urine therein.

The treatment consists prophylactically in avoiding the causes of the condition as far as possible, too tight packings, unnecessary trauma when operating in the region of the urethra, and the recognition preoperatively of strictures which might cause undue trouble during the postoperative period. Active treatment consists of a rectification of the pathology; when caused by edema, the application of moist heat to the part is indicated either indirectly by way of the perineum in the form of hot moist compresses or hot water bottles, or directly by hot douches in the female or rectal flushes in the male. Catheter-

ization is of course necessary to empty the overdistended bladder and suprapubic cystotomy would be required in a desperate case. By and large, this particular complication is mainly associated with surgical specialities, urology, gynecology, and can be dismissed briefly here.

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CHAPTER XI POSTOPERATIVE PULMONARY COMPLICATIONS

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CHAPTER XI

POSTOPERATIVE PULMONARY COMPLICATIONS

The subject of postoperative pulmonary complications is one in connection with which many differences of opinion exist. The experimental work which has been done on the subject is comparatively voluminous but, most of what is known concerning it is based on collections of clinical observations supplemented in many cases, it is true, by skiagraphic and other studies, but usually susceptible of many interpretations depending to a certain extent, at least, upon the inclinations of the interpreter.

All forms of clinical pulmonary complications may follow an operative procedure, pleurisy, abscess, gangrene, pneumothorax, atelectasis, bronchitis, infarction, embolism, pneumonia.

I. GENERAL INCIDENCE OF PULMONARY COMPLICATIONS

Lemon¹ estimates that 1 in every 50 patients operated upon may be expected to develop one or another type of post-operative pulmonary complication and that 1 patient out of every 185 will die as a result of such complication; he states that deaths from pneumonia alone following all types of operation average 9.5 per cent, whereas the morbidity rate averages 1.1 per cent for general surgery and 4.4 per cent for laparotomies.

The estimations of Cutler and Hunt^{2,3} are approximately the same; they estimate on the basis of 18,075 collected cases that 2 per cent of patients operated upon for any reason, 4 per cent of patients in laparotomy cases, and 8 per cent of upper abdominal operative cases develop such complications. McKesson,⁴ in 1918, found 3.03 per cent of lung complications in 39,438 cases. Males suffer from these complications more frequently than females, 2 to 1 (Whipple⁵) or 3 to 1 (Cleve-

land⁶); Featherstone⁷ estimates the ratio between the sexes in *stomach* cases as high as 4 to 1.

Pulmonary complications follow abdominal operations much more frequently than other varieties of operations as shown by the figures of Gwyn⁸; pulmonary complications subsequent to abdominal and pelvic operations, 102; subsequent to operations elsewhere in the body, 8. Similarly, Sise,⁹ in 1927, reporting on 3559 operations, concluded that the incidence of lung complications is lowest in operations on the extremities, head, and neck (0.5 per cent), much higher in operations upon the abdomen (lower abdomen 1.0 per cent), especially the upper abdomen (10.0 per cent).

Judging from such statistics as are available the incidence of postoperative pulmonary complications has been somewhat on the increase during the past quarter of a century.

Year	Author	Hospital	No. of Cases	Per Cent of Morbidity
1906	Armstrong ¹⁰	Montreal General	2,500	2,12
1908	von Lichtenberg ¹¹	(Collected)	23,673	1.9
1908	Ranzita	Eiselberg's Clinic at Vienna	6,871	3.8
1910	Beckman ¹³	Mayo Clinic	3,657	1.12
1912	Beckman ¹⁴	Mayo Clinic	5,835	1.57
1913	Beckman ¹⁵	Mayo Clinic	6,825	1.27
1917	Cutler & Morton ¹⁶	Mass. General	3,490	1.86
1918	McKesson4	(Collected)	39,438	3.03
1920	Cutler & Hunt ²	Peter Bent Brigham	1,562	3.52
1921	Cutler & Hunt ³	Peter Bent Brigham	1,604	3.92

In all probability, however, the increasing incidence is more apparent than real and represents actually an increasing vigilance in the recognition of the minor degrees of pulmonary complications previously overlooked.

II. MECHANISMS OF DEVELOPMENT

Three general mechanisms have been suggested as explaining the manner in which postoperative pulmonary complications become established:

- 1. The aspiration theory
- 2. The embolic theory
- 3. The theory of lymphatic extension

To these may be added a fourth:

4. The theory of atelectasis, which represents not a single mechanism, but rather a combination of several factors at present not particularly well known.

The theory of lymphatic extension may be dismissed very briefly, since it is fairly well established that such a theory cannot be conveniently invoked to explain that very large group of cases in which pulmonary complications ensue after operations on the upper respiratory tract, the lymphatic drainage of the oral cavity and of the neck being quite independent from that of the thorax. Most authorities at the present time are agreed that the hypothesis of lymphatic extension has little evidence in its favor.

There has been for a number of years, and there still continues to be, a rather ardent controversy over the relative importance of aspiration and embolism in the causation of postoperative pulmonary complications.

The earlier pulmonary complications follow so closely upon the administration of anesthetics in cases subjected to general inhalation anesthesia that almost from the time of the birth of anesthesia the anesthetic agent has been incriminated to some extent at least as the causative factor; formerly it was customary to speak of an "ether pneumonia" which was thought to be a particular kind of inflammatory reaction dependent solely upon the irritative action of the ether vapor inspired during the course of the anesthesia. It has been fairly conclusively demonstrated, however, that ether vapor per se is incapable of producing the tissue changes commonly found in this type of pneumonia; ether vapor alone apparently produces only a rather transient hyperemia accompanied by excessive mucous secretion. The aspiration theory, as at present understood, therefore, refers not to the aspiration of irritating anesthetic vapors as such but rather to the aspiration

of foreign material, blood, mucus, and pus, an accident facilitated by the unskilful induction of anesthesia.

Aspiration in this sense is held by many authorities to be the essential feature in the production of postoperative pulmonary complications; probably just as many other authorities accept the embolic theory.

- A. ASPIRATION THEORY: In connection with the aspiration theory it is fairly well established at present that during inhalation anesthesia material from the mouth, mucus, mixed with blood in cases of operations on the upper respiratory tract, is characteristically aspirated into the tracheobronchial tree to a greater or lesser extent depending upon two factors, (1) the depth of the anesthesia, and (b) the position of the patient.
- 1. Depth of Anesthesia: Myerson¹⁷ examined bronchoscopically 100 patients who had undergone tonsillectomy under light ether anesthesia. He found that 18 per cent of those in whom the anesthesia was so light that it did not abolish the cough reflex had aspirated mucus and blood below the level of the larynx, whereas 90 per cent of those cases in which the cough reflex had been completely abolished showed mucus below the level of the trachea.
- 2. Position of the Patient: Lemon¹ by the use of gentian violet, India ink and certain substances opaque to the x-rays showed in dogs that the position of the animal was of the utmost importance in preventing aspiration under general anesthesia. He found that the danger of such aspiration was much greater when the animal was placed in Fowler's position than when placed in the Trendelenburg position, the extreme Trendelenburg position obviating such aspiration completely. This author also showed that the danger of aspiration was markedly increased in cases in which the anesthesia was maintained at a level such that the animal struggled, breathed stertorously, swallowed, or vomited.
- B. EMBOLIC THEORY: The condition of gross pulmonary embolism has been recognized for many years and will be Book Page 396

discussed at greater length subsequently. The embolic theory of pulmonary complications, on the other hand, postulates a condition of minor embolism upon which more extensive pathological changes become subsequently engrafted.

The condition of minor embolism as a postoperative complication was first suggested by Mikulicz18 in 1900. That the significance of such a condition was not previously recognized is doubtless entirely due to the fact that it is difficult to differentiate at autopsy between areas of pneumonia, the fundamental basis of which is an embolism, and areas of pneumonia arising from other causes. Cutler,3 following Mikulicz's lead, and later Schleuter, Weidlein, Holmans, 19,20 and others have advanced and presented evidence to substantiate the theory that the large majority of postoperative pneumonic conditions, which formerly were considered due to infection of the lung through the respiratory tract as the result of the action of anesthetics, are actually embolic in origin. Cutler and his school have been able to demonstrate that it is virtually impossible experimentally to produce pulmonary infections by the aspiration route, i.e., as a result of the implantation of ordinary pathogenic bacteria into the tracheobronchial tree, whereas such is easy as the result of the introduction of infected emboli into the blood stream.

Against the embolic theory as the usual cause of postoperative pulmonary complications, however, at least three different lines of reasoning have been urged:

First: As Smith²¹ has recently demonstrated, it is perfectly possible to produce pulmonary abscesses in mice, guinea pigs, rabbits, and dogs by intratracheal inoculation of bloody material obtained from the region about the teeth of patients suffering from pyorrhea. In his experiments 50 per cent of the animals died of pneumonia, and 20 per cent developed pulmonary abscesses.

Second: When postoperative pulmonary lesions are examined bacteriologically it is customary to find two or more of the following organisms in the lesion: spirochetes, fusiform bacilli, cocci, and vibriones, organisms which occur characteristically in the tonsillar crypts and about the teeth. This is

strongly suggestive of the possibility that aspiration plays a pretty important rôle in the production of these postoperative pulmonary complications.

Third: As is well known, in embolic processes such as occur in conditions not associated with surgery, for example, in the pulmonary infarction of typhoid fever, pain and hemoptysis are outstanding symptoms, symptoms which are almost never present in cases of pulmonary complications arising in connection with operative procedures.

c. Atelectatic Theory: The graver degrees of atelectasis known as massive collapse have recently become well recognized clinical entities. The minor degrees of the condition, however, have become increasingly emphasized as a more definite knowledge of the underlying mechanics of the condition has been developed.

Mastics, Spittler, and McNamee²² have estimated that over 70 per cent of all the so-called postoperative and post-anesthetic pneumonias really represent a condition of atelectasis of varying degrees. Lee, Tucker, and Clerf^{23,24} have expressed the opinion "that the phenomena of pulmonary collapse of varying degrees, together with pulmonary embolism and infarction, are the real etiological factors in postoperative pulmonary complications."

Atelectasis is conveniently described by the advocates of the atelectatic theory in three degrees:

- 1. Massive atelectasis which involves more than one lobe of the lung,
 - 2. Lobar atelectasis which involves a single lobe of a lung,
- 3. Lobular atelectasis which involves scattered areas in one or several lobes.

The first, or massive atelectasis, may easily be mistaken for pleural effusion, empyema, or pneumothorax; the second is characteristically misdiagnosed lobar pneumonia; and the third is not infrequently mistaken for bronchopneumonia or pulmonary infarction.

That atelectasis is not peculiarly a postoperative phenomenon is attested by the fact that it has been recognized in a variety of conditions, such as (a) in non-penetrating wounds

of the thorax and abdomen, as well as (b) in injuries of the lower extremities, (c) in conditions of increased intra-abdominal tension, such as occur in intestinal obstruction and peritoneal effusion, (d) in association with tumors, (e) in connection with pharyngeal diphtheria, (f) in connection with foreign bodies lodged in the trachea and bronchi, and (g) also as a spontaneously occurring lesion.

Lee, Tucker, and Clerf²⁴ believe that two fundamental factors are involved in the production of atelectasis:

(1) the presence of a thick, viscid, bronchial secretion, and

(2) some inhibition of coughing.

They believe that because of the character of the secretion and the inability or disinclination of the patient to clear it from the bronchi by coughing, it accumulates in the bronchial tree until it finally completely obstructs the lumen at some point. Such an occurrence developing in a small bronchiole produces a lobular atelectasis, in a primary bronchus leading to a lobe a lobar atelectasis, and, in a main bronchus of either lung a massive atelectasis. Masses of thick, tenacious, viscid, bronchial secretion are sometimes found clinically and may be removed under favorable circumstances through a bronchoscope, a procedure which gives varying degrees of relief, depending probably upon the amount of time which has elapsed between the onset of the atelectasis and the institution of this measure for its relief.

Lee, Tucker, and Clerf²⁴ have succeeded in producing experimentally in the dog an atelectasis resembling in all points that characteristically seen as a postoperative complication in human beings by introducing mucous material derived from a clinical case of atelectasis into the bronchus of the animal, subsequently narcotizing the animal in such a way as to abolish the cough reflex. Lee, Ravdin, Tucker, and Pendergrass²⁵ believe that experimental atelectasis may be produced in animals by the use of any substance similar in physical properties to the viscid sputum characteristically found in cases of atelectasis, provided that only the cough reflex be

abolished. They have successfully used solutions of gum acacia for the purpose.

III. GENERAL CHARACTERISTICS OF POSTOPERATIVE PULMONARY COMPLICATIONS

Postoperative pulmonary infections differ from the ordinary infectious lung disorders in several particulars: (1) their onset is not accompanied by either chill or pleural pain, (2) they are only rarely associated with herpes labialis, (3) neither serous nor purulent effusions tend to accompany or follow them, and (4) the temperature and pulse rate rise very rapidly, becoming maximal within a very few hours.

IV. CLINICAL CLASSIFICATIONS

Probably no entirely satisfactory classification of postoperative pulmonary complications is possible at the present time. However, in order to discuss the subject at all some classification must be undertaken, and the one herewith proposed seems essentially correct.

A. PNEUMONIA: Lobar pneumonia, bronchopneumonia, and bronchitis have been recognized as the most frequent respiratory complications following operations performed under general anesthesia and may be discussed together as representing the clinical entity "postoperative pneumonia."

This complication must be divided clinically into two subclasses, (1) the so-called "early pneumonia" which is an accident connected immediately with the operation, and (2) the so-called "late-pneumonia," the symptoms and signs of which develop at the end of from forty-eight to seventy-two hours or longer.

1. Early Pneumonia: Early pneumonia is also called "aspiration pneumonia," "ether pneumonia," "postoperative bronchopneumonia," and "surgical pneumonitis," and is the most frequent type of complication encountered. It develops within a few hours of operation, often within twelve hours, and presents a progression of symptoms and signs similar, within

the previously mentioned general limitations, to those of an ordinary bronchitis or a lobular pneumonia. The rapidity of onset of the symptoms, the absence of pleural pain, the seasonal variation in incidence which is seen in this group, and the fact that almost all of the cases develop after ether anesthesia suggest that irritation of ether vapor and aspiratory infection are important ctiological factors in these cases. This type of complication is particularly prone to develop, therefore, in patients who have "taken" a general anesthetic poorly, in whom relaxation has been incomplete, who have vomited, and who have presented stertorous and labored breathing. Postoperative chilling may often play a part in the etiology.

Symptoms and Signs:

- 1. The temperature rises to from 101° to 105°F. without chill.
- 2. The breathing is rapid and shallow and is usually accompanied by exaggerated excursion of the upper part of the thorax.
 - 3. Pain is absent.
 - 4. The pulse is rapid and weak.
- 5. Cough is unproductive at first and unaccompanied by physical signs; later the cough is productive of purulent phlegm, and coarse scattered râles are heard; areas of bronchopneumonia may be found in both lungs at the bases.

The duration is from nine to ten days, during which the fever resolves by lysis. Empyema and lung abscess are not frequent complications. The mortality ranges between 20 and 60 per cent.

2. Late Pneumonia: The frequent time of occurrence of late pneumonia is from the eighth to the twelfth day postoperatively, but it may be observed from the second day to the third week. The interval between operation and the development of the complication is usually not entirely afebrile (about 1° of fever is noted), a circumstance which has been interpreted as indicating that this variety of pneumonia develops on the basis of infarction.

Symptoms:

- 1. Sudden onset occurs with pain in the chest, usually without chill.
 - 2. The breathing is shallow and rapid.
- 3. Cough is painful; about one-third of the cases have blood-tinged sputum.
- 4. Fever is moderate, 102° to 104°F., and characteristically of the septic type.
- 5. "Friction rub," diminished breath sounds, and localized dulness to percussion occur early, usually in the lower lobe of the right lung.
 - 6. X-ray findings are those of lobular consolidation.

Except in aged patients and in those debilitated from other causes this type of infection is not of serious prognosis as regards life, there being virtually no mortality, but it constitutes an added strain, especially unpleasant in laparotomies. Whipple⁵ and Cleveland²⁶ have apparently demonstrated that such cases of pneumonia are almost always due to the type IV pneumococcus; the other types of pneumococcus when they are the causative organisms tend to produce a type of pneumonia much more closely simulating ordinary lobar pneumonia. This type of complication may occur after either local or general anesthesia; it occurs after abdominal, pelvic, or nose and throat operations. It is occasionally accompanied or followed by empyema or lung abscess.

B. TREATMENT OF THE EARLY AND LATE PNEUMONIAS: The successful treatment of both the early and late pneumonias depends largely upon (1) recognizing the infection early, (2) careful nursing, (3) providing the patient with an abundance of oxygen, and (4) symptomatic treatment of the cough.

In providing oxygen advantage should be taken of any feasible opportunity to get the patient into the open air. Formerly it was customary to move the patient's bed to a porch or covered roof even in very cold weather and there to leave the patient, suitably protected, of course, from draughts by screens, in any but the most inclement weather. Many

internists at present believe such treatment to be too drastic in cold weather but that the "open air" treatment is quite suitable in warm weather all are agreed. In any case ample ventilation should be provided.

Since adequate ventilation of the lungs is hampered by the effect of gravity in the recumbent position, the patient should be propped upon a back-rest if at all feasible, and such a position may usually be maintained comfortably and without danger if a little ingenuity be exercised in the placing of pillows and in the improvisation of "slings" to relieve tension on the patient's muscles.

In the severer cases the administration of artificially prepared oxygen is of value in lowering the temperature, promoting the patient's comfort, and favoring his eventual recovery. The invocation of this measure should not be delayed until the situation has become desperate, because in such cases it is often of very little value.

Of course, an oxygen chamber is an excellent device, if such a chamber be available, but the installation of such a device involves a considerable financial expenditure, and accordingly an oxygen chamber is not often available. The lack of special equipment of this kind is not a very serious drawback, however, since a simple oxygen inhalation apparatus can be improvised readily for use almost anywhere. Many suitable varieties of apparatus have been devised. All that is necessarily required is an oxygen tank and a wash-bottle provided with a two-holed stopper, an entrance and exit tubes, an ordinary catheter, and some lengths of rubber tubing. The wash-bottle is partly filled with water; the catheter is passed through the nose well back into the nasopharynx of the patient and is fastened in place to the cheek by means of adhesive plaster; the release valve of the oxygen cylinder is now turned until bubbles of oxygen traverse the water in the wash-bottle in rapid succession but do not form a continuous stream (about 120 bubbles per minute) (Fig. 48). The concentration of oxygen (about 30 per cent by volume) which

can be supplied by such a device is not nearly so high as that obtainable in an oxygen chamber, but the results obtained by the method are usually quite satisfactory.

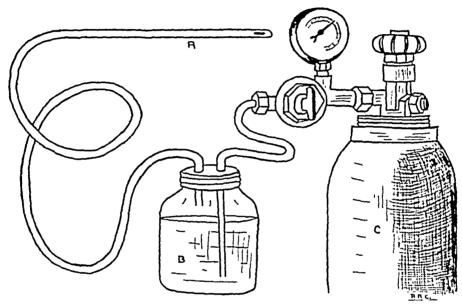


Fig. 48. Simple and reasonably efficient type of apparatus for the administration of either oxygen or carbon dioxide when regular anesthetic machines are not available. "A" is a rubber catheter which is introduced through the patient's nose into the nasopharynx. "B" is a wash-bottle partly filled with ordinary tap water and provided with a long entrance and a short exit tube. "C" is an oxygen or carbon dioxide tank as the case requires; it is provided with a gauge which shows the amount of pressure within the tank and an adjustable release valve. In operation the release valve is turned until bubbles of gas escape through the wash-bottle; the amount of gas can be roughly calculated by noting the rate of bubble formation. About 120 bubbles per minute is the average rate of flow when administering oxygen.

Pulmonary complications other than the pneumonias commonly ensue after four or five days and are most probably embolic in nature; they are not infrequently associated with femoral thrombophlebitis.

c. Pulmonary Infarction and Embolism: Etiologically infarction and embolism are closely related entities since both are embolic phenomena, the essential difference consisting in the relative size of the emboli.

1. Thrombotic Infarction: By pulmonary infarction is meant the series of organic changes and the train of clinical symptoms and signs occurring as the result of the dislodgment of a small

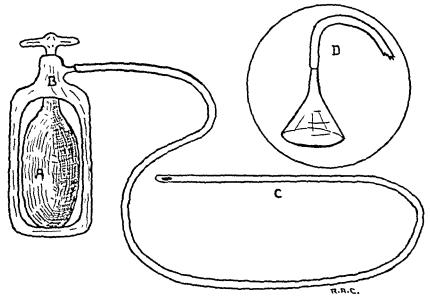


Fig. 49. A very simple and inexpensive apparatus for the emergency administration of carbon dioxide. "A" is a carbon dioxide cartridge such as is sold by the dozen commercially for carbonating water in siphon bottles for beverage purposes; it contains about 5 gallons of compressed gas. "B" is a perforator which serves the functions both of releasing the gas and regulating its flow. "c" is a rubber catheter which is introduced into the nostril of the patient. The eatheter should not be introduced very far into the nose when this apparatus is used because the flow of gas cannot be controlled very accurately, and overdosage is to be avoided. The apparatus can be made to terminate in a glass cone or funnel as shown at "D" if desired. This apparatus is so compact that it occupies but little room in a surgeon's handbag.1

embolus or of a number of small emboli, not large enough to occlude the arterial blood supply of an entire lobe, yet large enough to interrupt the blood supply to a part of a lobe of the lung. The clinical manifestations consist of sudden sharp pain in the chest, elevation of temperature, increase in pulse rate, dyspnea, cough and hemoptysis, accompanied by the development of friction rubs, râles, local impairment in percussion note, changes in breath sounds, and sometimes, in the severer cases, cyanosis and shock. The usual type of case presents the following features:

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¹ Hewer, C. L. The therapeutic value of carbon dioxide. China M. J., 41: 852, 1927.

Following the performance of a clean operation there ensues a period of from three to eight days of moderate fever, 100° to 103°F., for which no adequate explanation can be found; this, in turn, is followed by from one to twelve days of normal temperature, rarely more, and following this occurs acute pleural pain, the development of pleural friction rubs, and a recrudescence of the fever. Often associated with the chest condition, or occurring shortly after it, there are symptoms and signs of a femoral thrombophlebitis; not improbably in cases which do not show femoral thrombophlebitis and which present a similar type of history the pulmonary process is secondary to a silent phlebitis elsewhere, possibly often in the abdominal veins, particularly the pelvic veins. The explanation for the sequence of symptoms and signs is not far to seek; the initial febrile period is due to the formation of a thrombus in a vein and subsequent absorption of the blood clot; the ensuing afebrile period represents the period during which the thrombotic process is stationary, no more clot being laid down and no attempt at reabsorption yet having occurred. The pleuritic attack and febrile reaction represent the period of softening and absorption of the clot during which time particles break off from the main mass as emboli, are taken up by the circulation and lodge in the lung.

2. Thrombotic Embolism: By embolism is meant the anatomical changes and the clinical manifestations following the lodgment in the lung of an embolus of sufficient size to occlude the main trunk of the pulmonary artery or one of its principal branches.

Cases falling within this classification are almost always associated with thrombosis of the pelvic or femoral veins and according to common belief characteristically complicate operative procedures in the lower abdomen, such as hysterectomies and the removal of pelvic tumors, though such statistics as are available fail to substantiate the emphasis on lower abdominal surgery.

a. Incidence of Thrombotic Embolism: Vietor²⁷ collected 21 fatal cases of thrombotic embolism from 12,615 operative cases at the New York Hospital covering the ten-year period from January 1, 1915 to December 1, 1924. The average time of occurrence was thirteen days after operation; the shortest postoperative time interval was sixteen hours, and the longest was forty-seven days. Heard,²⁸ quoting statistics from

the Mayo Clinic from 1912 to 1920, reported 104 fatal cases in a series of 125,164 operations. Hampton and Wharton² reported 21 cases in 21,000 postoperative gynecological patients, of whom 19 died. Rupp³⁰ published a report of 59 cases of embolism occurring in 22,689 operations. Reports from the German literature by Oberndorfer³¹ and Detering³² indicate that the incidence of postoperative thrombosis and embolism has noticeably increased since the World War. Five cases of embolism have been reported following the injection treatment of varicose veins in a series of 53,000 cases.³³

b. Etiology: Various theories have been propounded to account for the formation of the thromboses which produce thrombotic embolism. Four factors are usually mentioned as predisposing causes: (1) sepsis, developing at the site of operation and producing septicemia or extending from the site of operation and involving the veins by continuity, (2) liberation of thrombokinase from the operative wound, (3) local trauma of small veins at the site of operation as by unduly powerful retraction, and subsequent spread of the thrombotic process from these veins to the external iliac or femoral veins, and (4) stasis in the large veins, due to a variety of causes, loss of fluids by purging, vomiting, and hemorrhage, the effect of posture of the patient during and subsequent to operation and depressions of the blood pressure due to hemorrhage, shock, or prolonged narcosis.

Of these various factors only the last seems to be supported by very conclusive evidence. Lister,³⁴ reporting statistics on 195 cases of postoperative thrombotic embolism from the Pathological Institute of the London Hospital, argues that if sepsis were an important factor appendicitis should be complicated by thrombotic embolism much more frequently than it is; if liberation of thrombokinase were an important factor extensive operative procedures like radical amputation of the breast and nephrectomy should be more frequently thus complicated than statistics show, and if powerful retraction of wounds were of important etiological significance statistics should indicate the fact.

Lister³⁴ after a very careful analysis of his cases was able to show that only two factors are of definite significance, (1) the age of the patient and (2) laparotomy incisions. In his cases the incidence of the condition was found to increase for every decade of life from the first to the seventh. The influence of abdominal incisions was very striking, about the only other surgical condition besides laparotomy which contributed any cases being fracture of the femur. Because of these latter findings he believes that the fundamental factor in the causation of thrombosis is venous stasis due to deficient muscular action, and he argues that incisions into the abdominal wall tend to produce the condition by decreasing the respiratory movements, thus interfering with the intraabdominal and intercostal pressure relationships, whereas fractures of the femur interfere directly with free venous flow through the lower extremity because they inhibit the massagelike action of the muscles of the thigh.

c. Clinical Characteristics: Thrombotic pulmonary embolism develops unexpectedly and suddenly in postoperative cases and usually results fatally. It is believed, following Aschoff's 35 teaching, that the thrombotic emboli which produce pulmonary embolism always arise either from the femoral vein or from the pelvic veins; the latter source is probably of very minor importance. The conformation of clots removed from patients dying of postoperative embolism usually indicates the source as the femoral vein. Occasionally fatal pulmonary embolism may occur without the slightest warning, i.e., it may not be preceded by symptoms of a preexisting phlebitis or thrombosis. At autopsy the source of the embolus may or may not be apparent, even when the autopsy is performed with the utmost care. Bernheim³⁶ has suggested that in many such cases the thrombotic process originates in the great veins of the neck.

Cases of thrombotic embolism may sometimes present the same clinical course as the preceding group (1) a febrile stage due to thrombosis, (2) an afebrile period of quiescence, and (3) the acute attack of thrombotic embolism. The clinical attack is relatively more severe than in cases of infarction, since the embolus concerned is larger, and the prognosis is more grave, the process either killing in a relatively short period of time or at best putting the life of the patient in jeopardy for some hours. Fatal embolism occurs as a complication of frank phlebitis but rarely according to Vietor, ²⁷ Brown, ³⁷ and Rowntree, ³⁸ and Miller and Rogers ³⁹ found only a 2.5 per cent association of phlebitis and embolism in 206 cases.

This complication usually ensues during the first or second postoperative week; the patient, who is often sufficiently convalescent to be up and about, suddenly develops a feeling of faintness, often accompanied by either precordial pain or a sense of tightness across the chest, incontinence of urine and feces may occur, and the patient usually feels faint and sinks to the floor. The onset characteristically occurs during some act of physical exertion, such as the first attempt at walking after the patient has been in bed for some time, straining at stool, or getting in or out of the bathtub. On examination dyspnea is characteristically marked, the face is cyanotic and wears an anxious expression, cold sweat is often present on the forehead, the pulse is rapid and weak, and the extremities are cold and clammy. There may be hemoptysis.

Usually death follows in from five to twenty minutes regardless of the combative therapy employed. Of 233 cases of pulmonary embolism collected by Lenormant 106 proved fatal,⁴⁰ but Heard,²⁸ collecting the statistics from the Mayo Clinic from 1912 to 1920 and covering 125,164 operations, reported only 5 recoveries in 104 cases; such reports, coupled with the relative incidence of postoperative pulmonary embolism as given by these authors (0.5 per cent as reported by Lenormant and only 0.08 per cent as reported by Heard) seems to indicate that possibly some of the cases reported

by the former author may not have been true pulmonary embolism; 99 of the 104 cases reported by Heard were proved at autopsy, but possibly certain patients who recovered or on whom an autopsy was not performed were overlooked by this author, so that possibly Heard's figures err in the direction of conservatism.

Cases of pulmonary embolism may be divided conveniently into three groups according to the ratio between the involved and the uninvolved portions of the lungs:

Group 1, in which a relatively considerable portion of the pulmonary circulation is obstructed, death following rapidly in these cases.

Group 11, in which death follows somewhat less rapidly, or in mild cases the patient recovering, only a relatively small part of the pulmonary circulation being involved, and

Group III, in which death does not occur for some days (two to three), the original embolic process involving only a small portion of the pulmonary circulation, but the process being progressive because of a superimposed thrombosis originating at the point of embolism.

d. Prophylactic Treatment: It is highly unfortunate that the etiology of thrombotic embolism is so incompletely understood, since in a process so fatal, and so rapidly fatal in the bargain, really the only treatment that is effective in the vast majority of cases is the prophylactic treatment of the underlying thrombosis, and this, in turn, cannot properly be applied in the absence of an understanding of the etiology. As previously stated it would seem that thrombolic pulmonary embolism following operative procedures is virtually non-existent except in those cases in which the abdomen has been opened, and consequently prophylactic measures become a matter of concern only in cases of laparotomy.

Most authorities are agreed that in the absence of more evidence then is at present available one cannot afford to overlook any of the factors that might possibly be responsible for the condition. They recommend the reduction of operative

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vascular traumatism to a minimum, since injury to the venous channels almost certainly favors thrombosis, and this, in turn, may give rise to the development of an embolus by the breaking off of a portion of the blood clot contained within the vessel. It has been suggested also that in a certain number of cases embolism may be dependent upon enforcement of the dorsal decubitus position, a position which favors thrombosis by slowing the general circulation, and accordingly many from this consideration alone favor reasonable changes of the patient's position in bed during convalescence in all but those few cases, mainly cases of grave general peritonitis, in which such changes of position would prove dangerous. Local tissue trauma and infection, as well as any condition such as the presence of a tumor, which slows the circulation locally, also presumably favor thrombosis, and any of these factors which can be alleviated should receive the attention of the medical attendant as a prophylactic precaution.

Because of the fact that certain cases are engrafted upon a condition of femoral thrombophlebitis various authors, following the lead of Whipple, have advocated the early postoperative institution of passive massage or active systematic exercises of the lower extremities in order to overcome any tendency to local venous stasis. Such exercises usually take the form of bicycle riding movements performed while the patient lies in dorsal decubitus.

Waters⁴¹ advocates the postoperative use of thyroid extract in doses of 2 grains three times per day on the theory that by increasing the metabolic rate the blood-pressure and rate of blood flow may be increased.

It would seem on theoretical grounds that dehydration should predispose to thrombus formation, and consequently a prophylactic measure of value would seem to be the administration of adequate quantities of fluid. Avoidance of shock and hemorrhage is of axiomatic importance. Following the lead of Lister³⁴ it would seem that measures designed to maintain normal respiratory movements are of the greatest importance.

The active treatment, once pulmonary embolism has developed, is in many cases nil, since death occurs too rapidly. In those patients who survive for a sufficient length of time, however, the first indication is to support respiration by elevating the patient to the sitting position and to supply oxygen if the condition seems to warrant this therapy and if oxygen is available. The peripheral circulation is supported by the application of heat to the periphery of the body most conveniently in the form of hot water bottles; venesection may possibly be of some value in selected cases to relieve embarrassment of the right side of the heart. Morphia may and should be given to counteract shock, and such methods of rapid stimulation of the respiratory and circulatory centers by drugs as may be thought to be of value may be employed. Trendelenburg's operation, which consists in evacuation of the blood clot from the pulmonary artery, may prove of lifesaving value occasionally and should be kept in mind as a possibility, though usually neither the case nor the circumstances are favorable for the successful performance of this procedure. The literature contains the records of a number of cases in which this particular operation has been adopted sometimes successfully and sometimes unsuccessfully. Mever^{42,43} reported 2 cases of which only 1 was successful. Nystrom44 reported 3 cases, only 1 of which was successful; de Harven⁴⁵ had 3 cases, all fatal; and Crafford⁴⁶ 2 cases, both successful. The latest report by Westerborn^{47a} states that 16 cases have now been recorded in the literature, 7 of which were definitely cured whereas the remaining o patients survived the operation but a short time. The value of the procedure in any case is open to question since it cannot be determined whether or not the successful cases would have recovered anyway even had the operation not been invoked.

3. Fat Embolism: a. Etiology: The blood stream normally contains a certain amount of neutral fat which, however, even in digestive lipemia, in which condition the normal content is greatly augmented, is so finely divided that the particles do not become visible when treated with fat stains. Fat embolism cannot occur as a result of the presence of such a fine emulsion. Only when conglomerations of fat of comparatively large size find their way into the circulation or are formed within the circulating blood by a process of agglomeration can symptoms arise. The symptoms are due to blockage of terminal radicles of the vascular tree by fat globules so large as to produce local or generalized circulatory embarrassment.

According to the usually accredited conception, fat embolism is a condition which arises only as a complication of surgical or other severe traumata. It is caused by the ingress of liquid fat into the blood stream. The fat usually finds its way into the circulation through the lumen of a ruptured blood vessel, but may possibly under exceptional circumstances be discharged into the circulation through the thoracic duct. The fat is derived from the patient's own tissues, and consequently there is always danger of fat embolism, in any case in which the traumatized area is rich in fat, like the marrow of the long bones in fractures and the panniculus adiposus of obese individuals in abdominal surgery; in short, fat embolism becomes a possibility whenever the fat reservoirs of the body are traumatized sufficiently to produce an uninterrupted communicating passageway between globules of tissue fat and the venous radicles of the vascular tree. Because of the rigid structure of bone it is supposed that the blood vessels in the osseous tissues are more apt to remain patulent and that fat embolism thus becomes an especial danger in cases of both accidental and surgical trauma to bones.

Largely as a result of the researches of Lehman⁴⁷ and his co-workers, however, this hypothesis seems at present to be in need of certain revisions. Many investigators have noted the occurrence of fat embolism in a variety of non-surgical and

non-traumatic cases coming to autopsy, specifically in cases of cardiovascular-renal disease, burns, postinfluenzal pneumonia, eclampsia, diabetes, phosphorus poisoning, and acidosis, and occasionally in many other conditions, such as profound sepsis, chronic alcoholism, acute pancreatitis, splenitis, sarcomatosis, and carcinomatosis. 47 It seems probable that in such cases some other mechanism beside discharge into the blood stream of free fat from the fat reservoirs of the body must be operative. Furthermore, as has been appreciated for a long time even in cases of trauma the amount of fat occurring in fat embolism, as demonstrated at autopsy, is frequently out of all proportion to the amount which might reasonably be expected to be derivable from the area traumatized. The possibility of the occurrence of agglomeration of emulsified particles of fat normally circulating in the blood stream has, therefore, been investigated. It has been shown that the prolonged administration of ether during the lipemic stage of digestion of a fatty meal is capable of producing fat embolism. Apparently the mechanism is one in which emulsified particles of fat coalesce to form macroscopic globules. Furthermore, in the test tube, at least, crushed muscle, hemoglobin, and histamine have been found capable of producing just such a phenomenon; all three of these substances, of course, may very easily find entrance into the blood stream. Possibly the most convincing link in the chain of evidence, however, is the experimental finding that dogs tolerate without showing symptoms the artificial introduction into the blood stream of an amount of fat which, weight for weight, is considerably greater than could possibly be freed in the human being by fracture even of the femur.

It is believed by some authorities that the condition of fat embolism is of relatively frequent occurrence, but that the condition is usually of a degree so minor as to be clinically recognizable but seldom. In line with this conception Lehman and his co-workers⁴⁷ have ventured the hypothesis that many of the cases of postoperative pneumonia are fundamentally due to a process of fat embolism. They have found marked scarring of the lung in post-mortem examinations performed some time after the production of fat embolism, a histopathological picture which corresponds very closely with that found in late cases of bronchopneumonia and bronchitis.

Elting and Martin⁴⁸ believe that fat embolism accounts for a number of deaths for which the assigned cause is "shock. toxemia, infection, or concussion," and that fatal cases are particularly prone to occur in connection with fractures of the long bones, especially the femora. They see in the tendency to patency of the blood vessels of the bone marrow and Haversian canals the predisposing cause, and in hemorrhage, edema, inflammation, manipulation, and tight bandaging the exciting cause, i.e., the pressure which dislodges the fat and forces it into circulation. These authors extracted the fat from weighed portions of the lungs and spleen in 2 fatal cases of fat embolism proved at autopsy and compared the fat content with that of the lungs and spleen taken from patients dying from other causes. They found the fat content markedly increased in the cases of fat embolism, of the order of three or more times as great as the normal value.

Accumulation of fat in the capillaries may be sufficiently rapid to give rise to symptoms very soon after operation or trauma, or the process may be more slow, and symptoms may not arise for several days.

In fatal cases the symptoms described have been not dissimilar to those found in cases of shock. (1) There is an increase of temperature, pulse, and respiration rate, (2) early restlessness develops into a condition of delirium, coma, and finally death.

In all cases, the fat emboli, being derived from the systemic circulation, are first carried to the right side of the heart. If the amount of fat be great, it has been supposed that it may here act like an air embolus and embarrass the atrium (auricle) in its efforts to empty itself, thereby causing death in the severest cases.

If the heart be successful in passing the fat out of its chambers, as it usually is, the fat may find its way directly into the coronary circulation and produce multiple small cardiac infarcts; it is believed that most of the cardiac symptoms are produced in this manner. Most of the fat, however, passes directly into the pulmonary circulation and produces edema, congestion, hemorrhage, and rarely infarction of the lung substance.

Such emboli as find their way through the pulmonary circulation may eventually lodge in any of the organs in the body. Lesions have been described in the liver, spleen, kidneys, skin, pancreas, thyroid gland, voluntary muscles, and in fact all of the tissues of the body. Of especial importance is the lodgment of emboli in the brain tissue, since embolism of this tissue may give rise to very dramatic effects depending upon the portion involved.

b. Symptoms and Signs: It is customary for clinical symptoms of fat embolism to develop if at all on the second or third day following extensive fractures of the long bones or extensive operative procedures involving the bone marrow or other tissue rich in fat. Symptoms may occasionally develop much more rapidly or, in other cases, may be delayed for a number of days. According to most observers the earlier the development of symptoms, the more apt is the case to result fatally.

The symptoms and signs depend largely upon the site of the embolic process.

- (1) If the heart and lungs be primarily affected the syndrome is primarily "cardiorespiratory."
 - (a) Symptoms: There is precordial distress accompanied by dyspnea and cough.
 - (b) Signs: The patient is usually cyanosed, the pulse rapid and irregular, the systolic blood-pressure is low, and there may be hemoptysis. The heart may show dilatation and over the lungs may be heard moist bubbling râles, due to the presence of pulmonary edema; there is usually little or no impair-

ment of pulmonary resonance. The temperature is not much elevated at first but gradually rises to 103°F. or more, and the development of Cheyne-Stokes respiration occurs terminally.

- (2) In the case in which the embolism is chiefly cerebral, the cases present the following signs and symptoms:
 - (a) At first there occur symptoms which are irritative in type: restlessness, delirium, hallucinations, and drowsiness. Tremors, spasms, or actual convulsions may also occur in this stage.
 - (b) During the later phases of the irritative stage and characteristically in the terminal stage occur stupor and coma; paralysis and death close the scene.

The Cheyne-Stokes type of respiration may be due to embolism of the respiratory center, and embolism of the temperature regulating center may explain the changes in temperature which are characteristically seen; embolism of the vasomotor center may explain the symptoms of shock.

The clinical course of patients suffering from fat embolism may be either rapid or slow. Certain cases show a fulminating course, apoplectiform in type, and death may ensue in a very few hours. Others persist for days or weeks and may or may not eventually recover. As previously stated, the longer the patient lives the better the prognosis becomes.

c. Treatment: Once a case of fat embolism has developed there is little that can be done beyond the institution of symptomatic treatment. The fundamental treatment is, of course, prophylactic and consists of gentleness in handling tissues rich in fat during operative procedures and immobilization and subsequent general and local rest of cases with fractures of the long bones. Granting that the prolonged administration of the fat-dissolving general inhalation anesthetics predisposed to the condition, an added indication is presented for limiting the duration of such anesthesia to a minimum. Venesection, intravenous injection of saline solution, and the production of a fistula of the thoracic duct are measures

which have been proposed but seem at the present time to offer very little promise as curative measures.

v. Massive Collapse of the Lung (Massive Atelectasis)

A. Historical: To the Englishman, William Pasteur, is usually given credit for having originally described massive collapse of the lung. In September, 1890,⁴⁹ Pasteur reported 15 cases of massive collapse occurring in connection with postdiphtheric paralysis in which, he said, the muscles of ordinary respiration, especially the diaphragm, had become more or less involved. Pasteur saw and studied his first case four years previously, that is, in 1886; in 1888, he saw 5 cases and in 1899, 9 cases.

That massive collapse of the lung was known, however, previous to the classical description of Pasteur there can be no doubt, since at least as early as 1853 Gairdner⁵⁰ apparently not only recognized collapse of the lung in adults but offered the explanation that it is caused by (1) the existence of mucus in the bronchi, (2) weakness or inefficiency of the inspiratory power, however caused, and (3) inability to cough and expectorate and thus to remove obstructive mucus. As early as 1878 collapse of the lung had been subjected to experimental investigation by Lichthein, 51 who reported two series of experiments on rabbits, in the first of which he blocked the bronchi by introducing laminaria plugs, and succeeded in producing collapse of the lung, and in the second he not only blocked the bronchi but ligated the vessels to the obstructed pulmonary area, and was not in this case able to produce collapse because, as he explained, absorption of alveolar air must be effected by the circulation in order for collapse to occur, no absorption taking place in those cases in which the circulation is interrupted.

Pasteur deserves credit, however, for having given the classical clinical description of collapse of the lung, for having emphasized the importance of the condition, and for having predicted the occurrence of postoperative collapse long before

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clinical cases had been reported. Pasteur made this latter prediction in his Bradshaw lecture in 1908,⁵² and in 1914⁵³ he was able to report 16 cases of postoperative massive collapse collected from a series of 201 cases of postoperative pulmonary complications. In the same year, 1914, Elliott and Dingley⁵⁴ reported 11 cases of postoperative collapse. Scrimger,⁵⁵ in 1921, was the first American author to report postoperative massive collapse of the lung; he reported 7 cases occurring in a series of 540 consecutive operations and extending over a period of one year. Scott,⁵⁶ in 1925, in a complete review was able to collect only 64 cases from the literature. Since 1925 much has been written and many more cases have been reported.

Since 1925 there has been a constantly increasing suspicion, amounting to a conviction amongst a considerable number of investigators, that collapse of the lung of one degree or another is responsible for a high percentage of all postoperative pulmonary complications. According to this conception massive collapse is but an exaggerated form of a less serious, because less extensive, and much more frequent complication, viz., "atelectasis." Mastics, Spittler, and McNamee,²² in 1917, voiced the belief that 70 per cent of all pulmonary complications are comprised by atelectases, and reported 50 cases which they classified as "fulminant," "moderate," "mild," and "evanescent"; they reported 13 cases of the first variety, 17 of the second, 15 of the third, and 5 of the fourth.

Atelectasis, following the suggestion of Jackson and Lee,⁵⁷ may be reserved for those cases in which a deflation of lung tissue, but not of the bronchi, occurs in a previously well acrated lung, and this condition may affect the entire lung or any smaller part of it. "Collapse" is in this case reserved for those cases in which not only the alveolar tissue itself but also the bronchi are collapsed.

Both atelectasis and collapse have been encountered following all kinds of abdominal operations and following the

induction of all kinds of anesthesia, including local and spinal analgesias; the condition is found following gunshot wounds of the abdomen, chest, and thighs, in connection with fractures

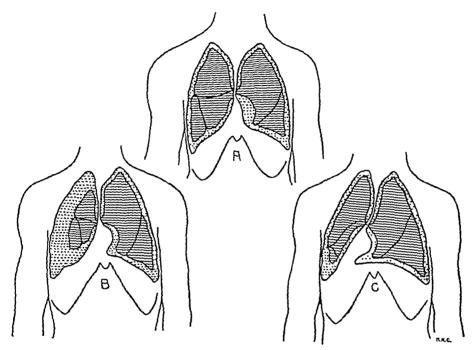


Fig. 50. Effect of pressure relationships in active and passive collapse of the lungs. At "A" is represented normal relationships of lungs, pleurae, and mediastinum. In "B" passive collapse of right lung has been produced by introducing air into right pleural cavity; right lung has become partly deflated by contraction of its intrinsic elastic tissue fibers, and right pleural space has been converted from a potential to a real cavity. In absence of fixation of mediastinum in such a case this structure tends to be displaced slightly to the opposite side, i.e., in this case to the left. In "c" active collapse of lower lobe of right lung is shown; right pleural cavity being still only a potential cavity and containing no air, mediastinum tends to shift to right, and a condition of compensatory emphysema in opposite lung occurs. It can readily be seen that artificial pneumothorax in this case would tend to restore normal pressure relationships and thus restore mediastinum to normal position.

of the femur and pelvis, and also in connection with nonpenetrating traumata to the chest.

B. THE MECHANICS OF PULMONARY COLLAPSE: Massive collapse of the lungs is essentially different from the collapse which occurs as a result of the production of pleural effusion or pneumothorax. The latter represents a process in which Book Page 420

intrapleural and intrapulmonic pressures are either partly or completely equalized; and collapse occurs by virtue of the inherent elasticity of the pulmonary tissues, especially the so-called "clastic" fibers. Such collapse may be designated as "passive" collapse.

Massive collapse, on the other hand, represents a condition in which the lung substance loses its air and contracts in the absence of initiating changes in intrathoracic, intrapleural, or intratracheal pressures; it represents "active" collapse, and when definitely established alters pressure relationships in the direction of still further increasing rather than relieving intrapleural negative pressure (Fig. 50). The term "collapse" has been criticized as implying that complete airlessness of the affected area occurs; this latter rarely or never happens, inasmuch as the bronchi characteristically remain patulent. "Atelectasis," however, is a less desirable term, since etymologically it means "failure of expansion," which condition is the reverse of the condition under discussion. "Apneumatosis" is more desirable as a descriptive term than "atelectasis," but seems to have little advantage over the original "collapse," while at the same time being much less expressive.

- c. Etiology: Several theories have been proposed to account for the production of massive collapse of the lung:
- 1. Paralytic Theory: This theory was originally advocated by Pasteur. It assumes that collapse is secondary merely to paralysis of the muscles of respiration, especially the diaphragm. This theory is probably untenable in its original form, since it is well known that paralysis of the diaphragm, produced either experimentally or surgically by section of both of the phrenic nerves, does not characteristically result in collapse.
- 2. Obstructive Theory: This theory is championed by Chevalier Jackson and his followers, Lee, Clerf, Tucker, and others. It assumes that the essential feature in collapse is the blocking of bronchi by masses of thick, tenacious secretion, and is, therefore, essentially a foreign-body atelectasis, such as has been known and recognized for many years. This theory

is interesting, but unfortunately does not seem to correspond with the facts in certain cases. Only a very few cases have been reported in which bronchoscopic examination has revealed the presence of such plugs in clinical patients, although it has been shown that the experimental introduction of such material into the bronchi of experimental animals is capable of producing the clinical and radiological picture of massive collapse.

- 3. Combined Obstruction and Impaired Respiratory Force Theory: This theory was originally proposed by Elliott and Dingley, and has since been championed by Churchill and others.
- 4. Postural Theory: Briscoe believed that prolonged quiet breathing in the supine position was capable of producing atelectasis, but fails to elucidate the mechanism of production further than this.
- 5. Vasomotor Theory: This theory, championed by Gwyn and Scott and Joelson, cannot be conveniently separated from the
- 6. Angioneurotic Theory, and both are at best somewhat nebulous. According to Scott and Joelson, the fundamental factor is a pulmonary reflex, probably vasomotor, which causes a partial bilateral obstruction in the peripheral respiratory passages. Superimposed upon this are the factors of the patient's position in bed and the secretion of tenacious material which makes the obstruction complete, characteristically on the dependent side. Air is then rapidly (in a few hours) absorbed from the affected lung, whereas a similar process is prevented from occurring in the opposite one by compensatory hyperventilation.
- 7. Reflex Spasm of the Bronchioles Theory: Since massive collapse does not occur in connection with asthma, in which reflex spasm of the bronchioles is presumably an outstanding phenomenon, this theory has little to recommend it.
- D. SYMPTOMS AND SIGNS: The symptoms and signs of collapse depend very largely upon the amount of lung tissue

involved, and they may appear either (a) with some suddenness or (b) may progressively develop during a period of hours. Any part of either lung may be involved in the process, but the right lung is more frequently involved than the left, most frequently the posterior portion of the right lower lobe. Involvement of the middle lobe of the right lung, together with the lower lobe, is next in frequency, then the lower left lobe, the upper right lobe, and the upper left lobe, in the order named.

(1) The severe case with sudden onset presents no particular diagnostic difficulties. It develops as a so-called "collapse attack." Usually within one to four days and most frequently within forty-eight hours after operation or trauma there develops pain in the chest, dyspnea, rapid pulse, and occasionally even cyanosis. The temperature usually is normal at first, but within a few hours becomes elevated to 102.5° to 103°F, and assumes an irregular character. Profuse diaphoresis ensues, and the cheeks usually present a brick-red discoloration as described by Soltau. 55 The posture of the patient is of diagnostic significance; he lies on the affected side with the dorsal spine bent and the head inclined to the affected side. Cough develops within a few hours, and a small amount of sputum, which is usually mucopurulent and never bloody or of the "prune juice" variety, may be expectorated. The leucocyte count early becomes somewhat elevated, and advances steadily to as high as 20,000 cells per cubic millimeter. On inspection the affected side appears smaller than the unaffected side, the intercostal spaces being diminished in width, and a marked respiratory lag is noted on the affected side. Tracheal displacement to the affected side may be found, especially when the site of the atelectasis is the upper right lobe. There is an apparent bulging and exaggerated respiratory excursion on the sound side which is explained by Osler⁵⁹ as due to a compensatory or vicarious emphysema.

The cardiac impulse is displaced to the affected side, this naturally being most noticeable in right-sided atelectasis; the

displacement may be obliquely upward and to the right in those cases in which the upper lobe of the right lung, either alone or in combination with the other lobes, is affected. The area of cardiac dullness may be obscured, however, by compensatory emphysema.

Impaired resonance, dullness, or flatness is present on percussion, vocal and tactile fremitus is early diminished, and the breath sounds are suppressed or absent over the affected area on auscultation. No râles are heard. This condition has been called "dead lung." Later in the course of the atelectasis increase in vocal and tactile fremitus with bronchophony and pectoriloquy may occur, together with the development of coarse bronchial râles and mucopurulent expectoration.

Complete disappearance of all signs usually occurs in from three to four days, but signs may disappear in the course of a few hours, with profuse expectoration of mucopurulent material, or they may clear slowly, during a period of one to two weeks during which time the symptoms and signs gradually abate. A certain number of cases develop a superimposed purulent bronchitis or bronchopneumonia, the onset of which is heralded by an exacerbation of the symptoms; râles appear over the affected area, and a blood-tinged expectoration ensues. Such cases may terminate fatally.

The roentgenological picture shows the dorsal vertebrae curved, with the concavity toward the affected side, the ribs converging on the affected side and diverging on the sound side, the heart and mediastinum are displaced toward the affected side, the dome of the diaphragm on the affected side is elevated and relatively immobile, and the lung fields show increased density on the affected side and decreased density on the sound side, changes which may be little or greatly apparent, according to the severity and extent of the atelectasis.

At autopsy the involved portion of the lung is blue or violet in color and sharply demarcated from the normal lung tissue. It is soft, tough, and wet; it feels heavy, does not

crepitate, and sinks when placed in water. Microscopically, the alveolar surfaces are closely approximated, the alveolar spaces being obliterated.⁶⁰

- (2) In certain cases there are no localizing signs referable to the chest. There is no pulmonary pain, little or no respiratory embarrassment, or elevation in the pulse rate. Cough, fever, and leucocytosis, which may develop, as in the first variety of case, are often discounted and at other times are correctly evaluated only incidentally as the result of routine chest examination or accidentally as the result of radiographic study.
- E. TREATMENT: In the absence of a definite and clear understanding of the mechanism of production, the treatment of massive collapse of the lung is of necessity symptomatic and relatively unsatisfactory. The condition very rarely gives cause for alarm, and apparently always tends to undergo spontaneous resolution in from one to four weeks in the absence of all treatment. For this reason Rose Bradford says that "no special treatment is indicated beyond encouraging, so far as the condition of the patient allows, the free movement of the chest in inspiration,"61 Sante, 62 however, has found that rolling the patient on the affected side and slapping the affected area, much as is done in attempting to bring about expansion of the lung in the newborn child, is of value, and occasionally results in the expulsion of tenacious secretion and the reinflation of the collapsed lung, as seen under direct roentgenoscopic examination.

Chevalier Jackson and his school believe that patients exhibiting collapse of the lung should be subjected to bronchoscopic examination in the hope of being able to remove obstructing plugs of secretion and thereby bring about a prompt radical cure of the condition. However, Jackson, himself, warns the surgeon against bronchoscopy at the hands of the inexpert operator since irreparable damage may be done by the bronchoscope when unskilfully handled.

Wilson⁶³ first suggested relief of the condition by the production of artificial pneumothorax, and Farris subsequently

reported 2 cases symptomatically relieved by this procedure. As previously stated, massive collapse represents a condition of local collapse in which the intrapleural pressure is actually decreased. Wilson, Farris, and later, Habliston, have shown that, whereas the normal intrapleural pressure varies between about 2.5 and 6 mm. of mercury (negative pressure), in cases of massive collapse pressures from -12 to 15 or even -25 to -32 mm. of mercury are occasionally encountered. It is believed by this school that the occurrence of the decrease of intrapleural pressure which accounts for the displacement of heart and trachea toward the affected side is not directly responsible for the symptoms. The latter arise, on the other hand, adventitiously, mainly as a result of cardiac displacement and resultant circulatory embarrassment. Reasoning from these premises, we find that the resumption of normal mechanical relationships of the heart and great vessels is the important desideratum. Because, however, of the fact that the condition rarely or never results fatally but, on the other hand, tends in all cases to undergo spontaneous resolution, such a radical procedure as the production of artificial pneumothorax would certainly seem ill-advised except under the most exceptional circumstances.

VI. THE IMPORTANCE OF PROPHYLAXIS IN PULMONARY COMPLICATIONS

Because of the relative frequency with which postoperative pulmonary complications occur and also because of the unsatisfactory character of the active treatment which at present can be applied to combat these complications after they have developed, considerable attention has been devoted by many investigators to the matter of prophylaxis. Although some consideration has already been given to this subject in discussing the various complications separately, a final word should be added with respect to the general importance of prophylaxis in pulmonary complications.

There can be no doubt that pulmonary infections are in most cases secondary to infections in the upper respiratory tract whether the mechanism of production be considered one of aspiration, embolism, or some other process. Of chief importance, therefore, in the prophylaxis of infectious pulmonary complications is the avoidance of elective operations on patients who show evidences of recent upper respiratory tract infections. In a series of cases studied by Whipple a morbidity of 15 per cent was found in patients who just previous to, or at the time of operation, presented evidence of a cold, whereas the general morbidity rate for all cases was 2 per cent or less.⁶⁴ Similarly Smith and Morton⁶⁵ found that 17 patients of a series of 28 cases who developed postoperative pneumonia gave a history of some respiratory tract infection at the time of operation, usually a common cold, and that in this group the complication characteristically developed promptly or at least within a day or two of operation and accounted for 7 of 22 deaths in the series attributed to postoperative pneumonia.

Because of the especial danger from postoperative pulmonary complications associated with laparotomy incisions in the upper abdomen particular care should be taken not only to avoid performing upper abdominal operations on patients who already show signs of respiratory infection, but also to avoid operating upon such patients during an epidemic of respiratory infection. It is a wise precaution to keep such patients under observation in the hospital for several days prior to operation in case they have recently been exposed to cold or dampness or to contact infection from other members of the family or other persons suffering from respiratory infections, in order that operation during the incubation period of such an infection may also be avoided.

When confronted with surgical emergencies patients presenting a history of recent or concurrent respiratory infections should be given the benefit of the most skilfully induced and maintained anesthesia available, providing general anes-

thesia is considered desirable, and in cases suitable for local or regional analgesia these methods should be given preference even though the advantage gained thereby is possibly not very great. With reference to the part played by the anesthetic in the development of pulmonary complications it should be remembered that lesions secondary to embolic processes can develop following one type of anesthesia as well as another, i.e., following local analgesia as well as general inhalation anesthesia, and embolic cases may follow crushing wounds and compound fractures in which no anesthetic at all has been used. Very few cases, however, which can properly be classed as inhalation pneumonia follow local analgesia.

The advantage of the Trendelenburg position when operating under general anesthesia should be recognized and heeded whenever possible; the advantage of such a position even when operating through lower abdominal incisions has been shown by Terry.⁶⁶

In patients not presenting frank upper respiration tract infections it is very widely believed that pulmonary infections become established only infrequently in cases in which the normal external respiratory movements are maintained, and that the essence of prophylaxis is the maintenance of unaltered pulmonary ventilation. Proceeding on this assumption it has been suggested that pulmonary complications may be attacked prophylactically from two points of view: (1) measures may be taken to determine which patients and which operative procedures present predispositions to such infections in order that one may know which patients require energetic prophylactic treatment, and (2) especially in those cases in which operative procedures tend to limit respiratory movements, measures may be taken both preoperatively and postoperatively to encourage undiminished ventilation or hyperventilation.

As a measure of the degree of depth of respiratory movements the so-called "vital capacity" of the lungs has customarily been used. Vital capacity consists of the volume of the greatest possible expiration immediately following the deepest possible inspiration. A certain amount of air remains in the lungs even after the most complete expiration, and this is known as the "residual air"; consequently the vital capacity of the lungs does not represent the entire air content of the lungs during full inspiration.

Briscoe⁶⁷ and more recently one of his pupils, Livingstone,⁶⁸ have shown that the vital capacity of the lungs is very markedly reduced simply by assuming a supine position; apparently therefore the mere assumption of the recumbent position favors the development of pulmonary complications.

In order to determine the degree of interference with the respiratory function caused by various operative procedures Head⁶⁹ measured the preoperative vital capacity of 26 patients who were about to undergo various operations and compared these values with measurements of vital capacity performed on succeeding postoperative days. From the results of these measurements he was able to conclude that operations on the stomach and in general all operations involving incisions into the epigastric angle were followed by maximal reductions which were of the order of magnitude of 78 to 88 per cent. Complete return to normal values had not occurred at the time of dismissal of patients from the hospital, or within a period of eighteen days in one instance. Operative procedures in the lower abdomen caused diminution of the vital capacity, but to a lesser extent, and the period of postoperative return to a normal level was also found to be shorter. Operations on the chest wall itself produced still less significant reductions in the vital capacity, and these reductions were also of shorter duration. Other operations like hemorrhoidectomy and various surgical manipulations on the testis caused only minimal and short-lived effects.

Similarly Powers⁷⁰ found that all abdominal operations decreased the vital capacity, but that the upper abdominal operations decreased the vital capacity maximally, and per contra that certain other operations, particularly operations

on the extremities and rectal operations, did not limit respiratory activity at all, or at least imperceptibly; the operation of thyroidectomy alone of neck operations was found to limit respiratory movements.

The most recent investigative work on the limitation of respiration caused by abdominal incisions is that of Patey⁷¹ who has shown by measurement of inspired and expired air, by skiagraphic examination of the diaphragm, and by tracings of intra-abdominal pressure variations that considerable interference with the normal respiratory mechanism occurs. This manifests itself particularly as a deficiency of expansion of the lung bases and an associated local venous stasis.

The most reasonable explanation for such findings is that the decrease in respiratory function is secondary to reflex inhibition of the activity of the respiratory muscles due to pain. The diaphragm when it descends depresses the abdominal viscera into the abdomen and in so doing raises the intra-abdominal tension; any increase in intra-abdominal pressure results in immediate tension on any suture-line which may be present in the abdominal wall and in the sensation of pain. In those cases in which the costal angle has been encroached upon by an incision the mechanics of the production of pain are even more direct, since the inspiratory elevation of the ribs exerts immediate traction on such an incision.

As a result of these findings various therapeutic measures have been advocated as of value in establishing and maintaining normal aeration of the lungs postoperatively in laparotomy patients. Amongst the most important of these are:

- (1) The avoidance of postoperative distension,
- (2) The use of morphine to control pain,
- (3) The institution of abdominal massage,
- (4) The administration of carbon dioxide or oxygen in an attempt to enforce pulmonary expansion,
 - (5) The adoption of systematic breathing exercises, and
 - (6) Postural therapy.

With respect to avoidance of postoperative distension and institution of abdominal massage little need be said. Abdominal distension should, of course, be minimized for other reasons than this and is universally regarded as undesirable. Abdominal massage cannot either adequately or comfortably be performed in the earliest postoperative period, and accordingly is probably a measure of little practical value.

With regard to the use of morphine, it should be remembered that although morphine does, of course, relieve pain and therefore tends to eliminate reflex curtailment of respiratory movements secondary thereto, it has, nevertheless, a direct sedative action on the respiratory center and from this point of view has obvious disadvantages. All in all, any indirect salutary effect this drug may have is probably counterbalanced by its direct sedative action.

Oxygen therapy has, of course, been used rather widely in the active treatment of postoperative pneumonia. Binger, Judd, Moore, and Wilder,⁷² Boothby and Haines,⁷³ and Passalacqua and Judd⁷⁴ have emphasized the value of oxygen in the treatment of postoperative pneumonia. They have found the course of the disease remarkably and favorably influenced by the use of this agent. In from eight to eighteen hours the temperature of the patients was found to return to normal, and although it rose again in from twenty-four to thirty-hours it terminated by crisis at the end of a forty-eight-hour period. The general clinical improvement of the patients was also found to be satisfactory; when receiving the oxygen the patients were more comfortable, phlegm loosened sooner, expectoration was easier, and physical changes in the lungs subsided in from four to five days.

Oxygen administration has also been used prophylactically with some apparent success by Passalacqua and Judd.⁷⁴ These observers have not only caused patients to breathe oxygen for a period of time before being removed from the operating table, a procedure which might very evidently be of value in producing hyperventilation of the lungs, but

apparently with the idea in mind that oxygen is of prophylactic value per se have injected the gas subcutaneously in the axillae in a few cases. From 200 to 400 c.c. were administered in this way, and absorption is reported to have occurred at the rate of 20 c.c. per minute. This latter procedure can hardly be accepted enthusiastically in the absence of more convincing evidence as to its value.

Carbon dioxide is administered by inhalation. The procedure in most common use is the immediate postoperative administration of a combination of carbon dioxide and oxygen before the patient leaves the operating table.

The therapeutic uses of carbon dioxide administration by inhalation has been appreciated generally only since 1920. Henderson and Hagard^{75,76} in that year first described the value of the method in facilitating elimination of carbon monoxide from the blood through the lungs. That the practical application of the hormone-like action of carbon dioxide on the respiratory center was not made earlier is remarkable, particularly in view of the unusual esteem in which the drug has come to be held in the few subsequent years.

Under ordinary conditions an adult individual consumes about 7 l. of air per minute. The concentration of carbon dioxide in ordinary atmospheric air is about 0.04 per cent. If the concentration of carbon dioxide be increased artificially to 5 per cent the volume of inspired air begins to increase almost immediately and within about twenty seconds 30 l. of gas are being inspired each minute. The increase of respiratory volume when analyzed is found to be secondary to increases in both rate and depth of respiratory movements, and the effect continues as long as the composition of the inspired air remains unchanged.

For therapeutic administration carbon dioxide mixtures containing more than 10 per cent of the gas are rarely given, not only because higher concentrations serve no useful purpose, but also because of the danger of overdosage; when patients are given this substance in too concentrated form they develop

pallor, rapid and irregular respiration, and fibrillary twitchings of the muscles of the face, carbon dioxide acidosis.

Carbon dioxide inhalations have found a field of usefulness in the treatment of a variety of conditions, such as carbon monoxide and illuminating gas poisoning, alcholic intoxication, asphyxia neonatorum, persistent singultus, postoperative empyema, trauma to the respiratory center, morphine poisoning and uremia. Their value in the treatment of these rather varied conditions depends (1) upon increased expansion, i.e., hyperventilation of the lung as such, (2) upon removal of harmful volatile substances from the blood as a secondary process, (3) upon an associated action on the muscles of respiration, especially the diaphragm, or (4) upon a combination of these processes.

In the prophylactic treatment of pulmonary complications advantage is taken of these actions as follows: (1) the duration of anesthesia in the use of the common inhalation anesthetics can be considerably shortened, and (2) thorough expansion of the lungs, especially at the bases, may be induced as frequently as may be desired.

Henderson, Haggard, and Coburn, in 1921, pointed out the ease with which patients could be de-etherized postoperatively by carbon dioxide inhalations, and, in 1923, White reported a series of 41 clinical cases so de-etherized using a mixture of about 5 per cent carbon dioxide in atmospheric air. White's patients experienced a return of consciousness which was from three to five times as rapid as that experienced by a control group of cases, and incidentally there was thought to be less postoperative nausea and vomiting in the treated series than in the untreated ones.

The value of de-etherization is believed to be confined mainly at least to the earlier period of recovery from the effects of the anesthetic for two reasons. (1) In accordance with the physical laws of the diffusion of gases from liquids, the greatest amount of anesthetic gas is liberated from the blood almost immediately, and the rate of diffusion thereafter progressively

decreases, until after a relatively short period of time very little gas is liberated per unit interval of time; inasmuch as the amount of gas eliminated latterly is minimal the time required for complete elimination is proportionally long; the net result is that although hyperventilation appreciably shortens the period of rapid elimination of an inhaled gas, the effect becomes progressively less and less apparent as time goes on. (2) As patients regain consciousness they characteristically become unmanageable under this form of therapy and violently resist attempts on the part of the anesthetist to continue the use of the method. Practically it has been found that carbon dioxide inhalations have ceased to serve any very apparent useful function after about twenty to thirty minutes. This amount of time, however, cannot well be spared under ordinary hospital conditions unless it can be shown that patients receive very definite benefits thereby, and accordingly it is customary to confine the use of carbon dioxide to a minimum time interval. viz., about five minutes.

Nitrous oxide and ethylene gases are much more volatile than ether vapor, and for this reason are eliminated with much greater rapidity. This consideration together with the fact that modern machines designed for the administration of nitrous oxide and ethylene are usually provided with accessory facilities for the administration of nitrous oxide oxygen mixtures makes denarcotization particularly easy and satisfactory in the use of the more diffusible gases. Thus Lundy⁷⁹ in a recent résumé of the use of carbon dioxide at the Mayo Clinic reports favorably on the use of carbon dioxide postoperatively during the five or more minutes during which the patient is on the operating table after the operative seance itself has been brought to a close and while dressings are being applied; in this short period of time he thinks enough hyperpnea can conveniently be induced to eliminate most of the anesthetic, if it be ether, and almost all of it if it be nitrous oxide or ethylene.

When carbon dioxide is used for purpose of de-etherization some sort of expiratory valve must, of course, be incorporated

in the inhaler employed, otherwise the anesthetic vapor will simply be rebreathed.

Churchill⁸⁰ apparently first called attention to the value of carbon dioxide in the expansion of atelectatic pulmonary tissue in connection with reexpansion of the lungs following thoracotomy for empyema.

Sufficient attention has already been paid to a consideration of the etiological relationship between hypoventilation, at electasis and pulmonary infection to emphasize the value of carbon dioxide inhalations or any other agent or method which tends to maintain normal or exaggerated expansion of the lungs. That administration of carbon dioxide performs this function most efficiently is hardly open to question and ultimately, therefore, the question of the prophylactic use or nonuse of the method becomes a matter of expediency. Some surgeons use the method more or less routinely and habitually keep on their wards one or more apparatuses for the inhalation of suitable carbon dioxide mixtures. When given as a matter of routine, the apparatus is wheeled to the bed of each patient several times during each twenty-four hours and enough gas mixture (usually 90 per cent oxygen and 10 per cent carbon dioxide) is given to stimulate hyperpnea for a period of a minute or two. All patients who are observed to be of poor color or to be breathing shallowly are subjected to the treatment at much more frequent intervals.

A rather simple and probably efficient method of prophylaxis of pulmonary complications is the encouragement of systematic deep breathing exercises. This is a procedure which requires no accessory equipment and no financial expense. It is undoubtedly not so efficient as carbon dioxide in expanding the lungs, partly at least because it is incapable of completely overcoming splinting of the respiratory muscles due to pain, but it is an almost universally applicable method. It is dependent for success upon cooperation between surgeon, attendants, and patient, and will succeed maximally only in those cases in which patients are intelligent and are intelli-

gently managed. The nursing staff can do much to aid in the proper administration of the method by being patient and encouraging. A five minute period of active effort in deep breathing should be required of laparotomy patients every hour for the first three or four postoperative days, if the method is to succeed, and the effort should be carried to the point of producing actual pain. These exercises should be begun just as early postoperatively as the cooperation of the patient can be enlisted, and a spirit of congenial rivalry can rather easily be fostered among patients in wards in the continuation of the process.

The importance of posture is probably not sufficiently realized. Not only does prolonged maintenance of the same local position favor gravitation of fluids to dependent portions of the lungs and thus tend to produce compression of lung substance, but these organs receive a certain amount of pressure directly through the bony thorax from the bed, and also from the weight of superimposed tissue, the heart, and the opposite lung. Frequent changes in the position of the patient tend to avoid prolonged compression of any particular part of the lungs and thus to minimize the formation of foci of lowered resistance. Furthermore it is not sufficiently appreciated that the mere assumption of the recumbent position causes areas of increased density to appear in the bases of the normal lung. In this connection Boland and Sheret have suggested elevating the foot of the bed 20 in. and removing pillows from under the head. In 47 patients thus treated in whom careful skiagraphic examinations were made all showed excellent aeration at the bases while the body remained inclined, although mottling occurred in certain cases when patients were lowered to the horizontal position.⁸¹

VII. THE VALUE OF ROENTGENOGRAMS IN THE DIAGNOSIS OF PULMONARY COMPLICATIONS

In view of the veritable flood of both clinical and experimental reports on postoperative pulmonary complications

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which have appeared within recent years a word or two of warning may be spoken on the fallacy of interpreting too closely the skiagraphic findings in films of the lung fields. Muller, Overholt, and Pendergrass⁸² have recently emphasized the fact which, to be sure, has been more or less clearly appreciated by many other investigators, that positive roentgenographic findings are by no means always associated with commensurate clinical reactions. The discovery, therefore, of areas of radiopacity especially at the bases of the lungs, haziness of the lung fields, and elevation of the diaphragm when discovered accidentally or when occurring in the absence of definite symptoms and signs must not be interpreted as necessarily abnormal. For the most part these findings represent the normal postoperative pulmonary picture; the expansion of the lung is very seriously curtailed, the diaphragm fails to descend properly, and areas of patchy atelectasis develop in the more dependent portions of the lung fields. If this fact be not borne in mind the surgeon can find "silent" pulmonary complications in most of his laparotomy cases merely by invoking the aid of the roentgenogram.

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DIAGNOSIS OF BONE TUMORS BY ASPIRATION*

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T is a fact well recognized by those who have occasion to deal with the problem of the treatment of bone tumors that a correct diagnosis is a matter of supreme importance. The treatment varies so widely in the different types of tumor, and in conditions simulating tumor, that it is essential that it be based on correct interpretation of the underlying pathology. Granting that clinical and roentgenographic evidence together enable us to make a correct diagnosis in the majority of instances, we are still faced with a considerable group of cases in which histological evidence is essential to avoid error.

Up to the present time material from tumors lying beneath the skin or mucous membrane has generally been obtained only by the use of direct surgical approach, i.e., by operative biopsy. The advantages and objections to this method have been stressed repeatedly by various authorities and it is not within the scope of this report to discuss them. Insofar as the operative biopsy is considered in relation to bone tumors, however, we feel that it must be regarded as a procedure not without risk. We do not advise it as routine, reserving it only for those few cases where the clinical and roentgenologic diagnosis is uncertain and a prompt decision as to the nature of the process is imperative.

While admitting that biopsy of bone tumors has, in numerous instances, resulted badly, chiefly owing to infection or fungation of tumor tissue through the biopsy wound, we believe that these bad results can largely be eliminated by greater care

and a more thorough understanding of the proper technique, and that its advantages outweigh its disadvantages. Another method of obtaining material for histological study will hereinafter be described.

Histological study of tissue aspirated from a series of cases with tumors has already been reported by Martin and Ellis. Their results show that the information gained in this manner has been of unquestionable value in establishing a diagnosis.

The method they describe has certain definite advantages over the formal biopsy. Of these may be mentioned the simplicity of the technique of obtaining the material for study; the fact that it can be carried out in the out-patient or examining department with little inconvenience to the patient; that it permits of immediate operation or radiation therapy without the lapse of time necessary for wound healing, as is the case when a formal biopsy is performed; and finally that it obviates hospitalization and consequent expense to the patient.

Certain theoretical disadvantages may be claimed for this method. For example, in some cases no tissue is obtained at aspiration; in others, tissue cells are obtained but they cannot be identified as tumor cells. The possibility must be kept in mind that viable tumor cells may be implanted along the needle tract; or that in the case of vascular tumors intratumoral hemorrhage may result, affording the opportunity for tumor cells to become dislodged into the blood stream and cause distant metastasis.

*From the Department of Bone Tumors, Memorial Hospital, New York. Read before the Orthopedic Section, Academy of Medicine, April 20, 1931.

We have not seen instances of tumor implantation along the tract of the needle, or of dissemination of the tumor that could be attributed to the aspiration.

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Martin suggested that the aspiration method might have a field of usefulness in the diagnosis of bone tumors. Accordingly, the Bone Department undertook this work in a series of cases, the results of which form the basis of this report.

ASPIRATION TECHNIQUE ADAPTED TO BONE TUMORS

We have included the description of the actual method of biopsy by aspiration by Martin and Ellis.* There are several points, however, in which the procedure differs from that used for soft part tumors.

The selection of the proper site for aspiration is more difficult in deeply situated tumors than in those on the surface. Aside from the anatomical relationships, central tumors are frequently encountered in which the bony shell may or may not be still intact. If radiographs show that it is broken at any point, it is advantageous to aspirate there. This was of particular importance in an aspiration of a tumor involving the neck of the femur. Radiographs showed that the cortex was broken on the upper side. With the proper position of the limb and angle of the needle, the procedure was relatively simple and a diagnosis of osteogenic sarcoma was obtained from the smear.

Novocaine infiltration of the skin and soft tissues is advisable before passing through to the deeply seated bone tumors. Adequate infiltration renders the procedure practically without pain.

A brief gas-oxygen anesthetic can be used if conditions warrant. It may be necessary in young or very nervous subjects.

There are several possible explanations for the failure to obtain cells. Some fibrous tumors, such as the osteogenic fibrosarcoma, may, by their texture, present great difficulty in aspiration. The

technique may be faulty. It seems certain that practice is necessary in order to obtain a high percentage of positive results. There are several methods of utilizing the material obtained. If there is but a minute amount of tissue, the smear is the only suitable one. In case layer plugs of tissue in cylindrical shape are expelled from the needle, as may happen under ideal conditions, a portion of the tissue may be hardened in formalin and parassin sections made in the usual manner. Many bone cases are extremely vascular and often yield what appears to be only blood. We find that if the blood clot is hardened and sectioned by the parassin method tumor cells are frequently demonstrable. In the majority of the cases cited two or more of these methods were used as checks on one another.

The syringeful of blood may be expelled through a few thicknesses of gauze which filters out floating particles of tumor; these may then be transferred to glass slides and smeared or, if of sufficient bulk, may be hardened and sectioned.

We have included a series of 35 consecutive cases of bone tumors on which aspiration has been performed. In each instance we have tabulated the clinical diagnosis, the diagnosis from x-ray films, and the report of the pathologist, based on the material aspirated. In addition, a high percentage of cases has been proved by the histological report from gross material obtained later either at operation or autopsy.

It will be at once apparent that the small fragments secured by aspiration are often sufficient only to permit of the report that malignant tumor cells are present or absent. In other cases the type of tumor can be ascertained. The pathologist in many cases has been able to classify the tumor with striking accuracy.

One of the fields of greatest usefulness of this method lies in the differentiation between chronic inflammatory conditions and true tumors; for example, in one instance the report of "fibrin and pus" was the deciding factor in diagnosis in the case of an unusual tumor of the phalanx

^{*} Biopsy by needle puncture and aspiration. Ann. Surg., 92: 169-181, 1930.

the thumb, about which we were most uncertain from clinical and roentgenray examinations.

ure (Case xxix) occurred when an aspiration diagnosis was made of osteogenic sarcoma and the later biopsy showed

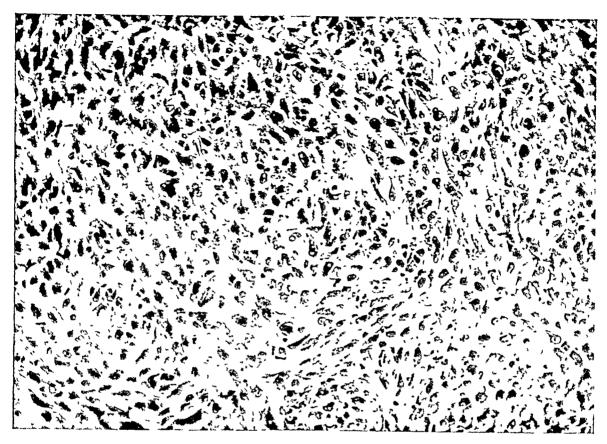


Fig. 1. Paraffin preparation of plug of tissue obtained at aspiration. Osteogenic sarcoma, Case IV.

Aspiration is adaptable to all types of bone tumors except those in which the tumor is deeply situated and surrounded by a zone of normal bone through which the needle cannot be made to penetrate. Fortunately, the majority of such tumors are susceptible of diagnosis without biopsy (most frequent examples of this type are giant-cell tumor, benign cyst, etc.). In a doubtful case the surgeon may have to resort to an operative biopsy.

As shown in Table 1, of the 35 cases in which aspiration biopsy was performed, the Iresult was checked by subsequent operative biopsy in 12 and by paraffin sections of formalin-hardened clot obtained at aspiration in 3. In Case xxx the aspiration diagnosis was not supported by the findings at a subsequent operative biopsy, the diagnosis at aspiration being osteogenic sarcoma and at operative biopsy metastatic adenocarcinoma. Another fail-

neurogenic sarcoma. In one case (xvII), the pathologist was unable to make a diagnosis.

Six cases have been selected from the series and are outlined briefly below in order to furnish a still better basis for a judgment of the advantages of this diagnostic procedure.

ILLUSTRATIVE CASES

Case IV. J. Z. A white male of fifty-seven years was admitted to Memorial Hospital November 11, 1929. The history started two months prior to admission with pain and swelling in the right shoulder which the patient attributed to a sprain. The swelling over the head of the humerus gradually increased in size.

Examination showed a well developed and poorly nourished man appearing chronically ill with marked loss of weight. There was a uniform swelling of the upper half of the right arm. In comparison with the left arm the

TABLE I

Case No.	Bone Aspirated	Clinical Diagnosis	X-ray Diagnosis	Aspiration Diagnosis	Operative Biopsy Diagnosis
M. G.	Scapula	Osteogenie sarcoma	Malignant primary bone tumor	"Spindle cell sarcoma— periosteal or medullary osteogenic sarcoma"	Paraffin section of blood clot confirms diagnosis by aspiration (smear)
S. S.	llium	Thyroid carcinoma metastasis	Carcinoma metas-	"Malignant tumor"	Biopsy (from thyroid) con- firms aspiration diagnosis
m N.M.	Mandible	Giant-cell tumor	Epulis	"Typical giant-cell epulis"	Biopsy confirms aspiration diagnosis
J. Z.	Humerus	Osteogenic sarcoma	Primary bone tumor	"Spindle cell sarcoma, i. c., osteogenie sarcoma"	Paraffin section of aspi- rated blood clot confirms diagnosis by aspiration (smear)
` A. F.	Phalanx	Question of inflam- mation or tumor	Giant-cell tumor	"Fibrin and pus; possibly tuberculosis"	Biopsy confirms aspiration diagnosis of tuberculosis
L W.	Metatarsal	Malignant bone tu- mor	Medullary malig- nant tumor	"Malignant tumor—un- classified"	No biopsy
J. W.	Scapula	Primary bone tu-	Osteitis fibrosis cy- stica	"Rare spindle cells, sug- gesting sarcoma—no defi- nite diagnosis"	No biopsy
viii H. S	llium	Osteogenic sarcoma	Osteogenic sarcoma	"Tumor cells present-type seen in benign giant-cell tumor unless clinically compatible would make no diagnosis"	No biopsv
J. D.	Ilium	Thyroid carcinoma metastasis	Metastatic carci- noma	"Looks like metastatic- carcinoma—no features of osteogenic sarcoma"	No biopsy
» P. V.	Superior maxilla	Tumor of antrum	Destruction of bone —carcinoma	"Osteogenie sarcoma— spindle cells—not a true bone former"	Biopsy confirms aspiration diagnosis
C G	Hium	Osteochondrosar- coma	Osteochondrosar- coma	"Masses of atypical cartilage—unable to tell whether chondrosarcoma or chondroma"	No biopsy
I. G	Rib	Endothelial myeloma	Endothelial mye- loma	"Strongly suggests broken down endothelial mye- loma"	Parassin section of aspi- rated tissue consirms diag- nosis on smear
A Y	Clavicle	Endothelial mye-	Endothelial mye- loma	"Fibrin and pus—no tu- mor cells present"	No biopsy
xıv F H	Femur	Osteogenic sar- coma Myosarcoma	Osteogenic sarcoma	"Large tumor giant cells- suspect myosarcoma"	No biopsy

circumference was 8 cm. greater. The tumor was hard and not movable over the humerus. The arm had only slight motion and that was accompanied by pain. Paget's disease of the bone was observed in the skull, left femur and tibia.

X-ray Report: "Films of the skull, left femur, pelvis and tibia reveal characteristic features of Paget's disease. Stereoscopic views of the left shoulder girdle reveal the presence of the same process in the clavicle, scapula and humerus. In addition a large area of bone destruction is noted in the upper third of the shaft of the left humerus."

Aspiration Smear: "Osteogenic sarcoma, spindle-cell type." This diagnosis was confirmed by a paraffin preparation of the aspirated plug of tissue obtained from the needle, as shown in the illustration.

Case v. A. F. A white male of fifteen years was admitted to Memorial Hospital August 9, 1929. The history started one year prior to admission when the left thumb was sprained while the patient was catching a baseball. There was intermittent pain, but not severe enough to cause the patient to favor the hand. However, one week ago abnormal motion was noted and an x-ray showed a pathological fracture of the first phalanx of the left thumb.

Examination showed the left thumb to be diffusely swollen throughout the middle and proximal phalanges. This was most marked at the distal end of the proximal phalanx and it was here that abnormal painless motion was found.

Clinical Diagnosis: Osteitis fibrosa cystica. X-ray Report: "There is a giant-cell tumor

TABLE I (Continued)

	1	1	ABLE I (Continued			
Case No.	Bone Aspirated	Clinical Diagnosis	X-ray Diagnosis	Aspiration Diagnosis	Operative Biopsy Diagnosis	
L. B.	Superior maxilla	Carcinoma of antrum	Destructive tumor	"Chondrosarcoma"	Biopsy confirms aspiration diagnosis	
S. K.	Femur	Primary bone tu- mor	Osteogenic sarcoma	"Malignant giant cell tu- mor—relatively radio- sensitive"	No biopsy	
C. R.	Ilium	Primary bone tu- mor	Bone involvement —not character- istic	"Unable to make any diagnosis"	Biopsy section—"prob- ably osteogenic sarcoma"	
S. B.	Clavicle	Primary bone tu- mor	Bone involvement —not character- istic	"Plasma cell myeloma al- most certain"	No biopsy	
C. P.	Sternum	Ostcogenic sarcoma	Osteogenic sarcoma	"Chondrosarcoma or chon- droma"	No biopsy	
xx P. Z.	Rib	Multiple mycloma	Extensive bone de- struction	"Malignant tumor—un- classified"	Malignant tumor suggests plasma cell myeloma	
M. G.	Femur	Osteogenic sarcoma	Bone involvement —not character- istic	"Osteogenie sarcoma"	No biopsy	
S. P.	Skull	Metastatic carci-	Metastatie carci- noma	"Tumor cells present- type not determined	No biopsy	
D. A.	Skull	Metastatic carci- noma	Metastatic carci- noma	"Carcinoma"	No biopsy	
XXIV A. K.	Femur	Endothelial mye- loma	Endothelial mye- loma	"Tumor cells present— unclassified"	No biopsy	
A. P.	Jaw	Osteogenic sarcoma	Destruction of bone	"Cellular neoplastic osteo- genic sarcoma"	Biopsy confirms aspiration diagnosis	
XXVI B. M.	Fibula	Osteogenic sarcoma	Osteogenic sarcoma	"Osteogenic sarcoma"	Biopsy confirms aspiration diagnosis	
XXVII P. M.	Rib	Chondrosarcoma	Chondrosarcoma	"Chondrosarcoma"	No biopsy	
XXVIII N. C.	Sternum	Metastatic thyroid carcinoma	Destruction of bone	"Carcinoma"	No biopsy	
XXIX M. R.	Right tibia	Fibrosarcoma	Osteogenic sarcoma	"Osteogenic sarcoma"	Neurogenic sarcoma Grade 11. Aspiration failure	
G, G.	Sacroiline region	Osteogenic sarcoma	Metastatic carci- noma	"Osteogenic sarcoma"	Metastatic adenocarci- noma. Aspiration failure	
xxxi L. B.	Rib	Metastatic carci- noma—primary— undetermined	Extensive metas- tases in lungs and ribs	"Malignant tumor—most suggestive of metastatic carcinoma, but unwilling to diagnose on aspiration"		
J. W.	Os calcis	Sarcoma of tibia	?	"Very cellular, highly ma- lignant tumor—looks like endothelial myeloma"	Endothelial myeloma. Biopsy confirmation	
XXXIII A, L.	Mandible	Giant cell tumor mandible	Osteogenic sarcoma	"Chondrosarcoma"	Biopsy confirms aspiration diagnosis of osteogenic sarcoma (chondromyxo- sarcoma)	
xxxiv 1. A.	Sternum	Carcinoma of thy- roid with metas- tases	Metastatic tumor of sternum	"Malignant tumor might be a thyroid tu- mor, spindle cell variety; some alveolar arrange- ments"	No biopsy	
XXXV H, E, M.	Humerus	Osteogenic sarcoma	Osteogenic sacroma	"Ostcogenic sarcoma"	Biopsy confirms aspiration diagnosis	

of the distal half of the proximal phalanx of the left thumb with fracture, which does not involve the joint surface."

Aspiration: April 2, 1930, showed fibrin and pus; no tumor.

Biopsy: April 16, 1930, demonstrated tuber-culosis.

Case III. N. M. A white male of seven years was admitted to Memorial Hospital November

20, 1929. The history started six months prior to admission with a toothache in the left lower jaw. The first molar tooth was extracted.

naris was completely blocked. The oral cavity was negative.

X-ray Report: "The left antrum is markedly

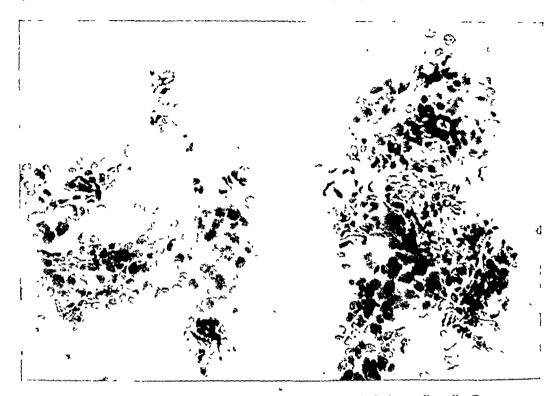


Fig. 2. Smear of aspirated material demonstrating a typical giant cell epulis. Case v.

Two months later the gum around the empty socket began to enlarge. In August, 1929, the tumor was excised and the wound healed quickly. There was an immediate recurrence.

Examination showed the left lower first molar, bicuspid and canine to be absent and in their place was a large, soft, purplish tumor.

X-ray Report: "Well defined rarefaction in the left mandible, as seen with epulis."

Aspiration: November 26, 1929, typical giant-cell epulis, as shown in the accompanying llustration. Biopsy performed two weeks later confirmed this diagnosis.

CASE X. P. V. A white male of three years was admitted to Memorial Hospital April 29, 1930. The history started six weeks prior to admission with lacrimation of the right eye and subsequent swelling of the right cheek without pain.

Examination showed a moderate exophthalmos to be present without pupillary or retinal changes. The right cheek was swollen and particularly prominent over the zygoma where the tumor had bony hardness. The right

cloudy and its walls are irregular in outline. The appearance suggests extensive involvement. Diagnosis: carcinoma."

Aspiration smear under gas oxygen showed, "osteogenic sarcoma—spindle cells—not a true bone former." Biopsy performed ten days later confirmed this diagnosis.

Case XII. I. G. A white male of twenty-six years was admitted to Memorial Hospital September 9, 1929. The history started three weeks prior to admission with a cold. When the physician was examining the chest at that time he noticed a lump over the right eighth rib anteriorly. Two weeks later a pleuritic pain appeared in the region of the swelling. This pain was relieved by strapping.

On examination an ovoid tumor was found over the anterior end of the right eighth rib. It was approximately 4 cm. in diameter and had a slightly spongy texture.

X-ray Report: "Extensive destruction of the anterior end of the right eighth rib is noted in this film of the chest."

Aspiration Smear: "Strongly suggests broken down endothelial myeloma."

A paraffin section from the blood clot

The section of the rib removed later showed considerable productive osteitis. The marrow was filled in places with plasma cells and with

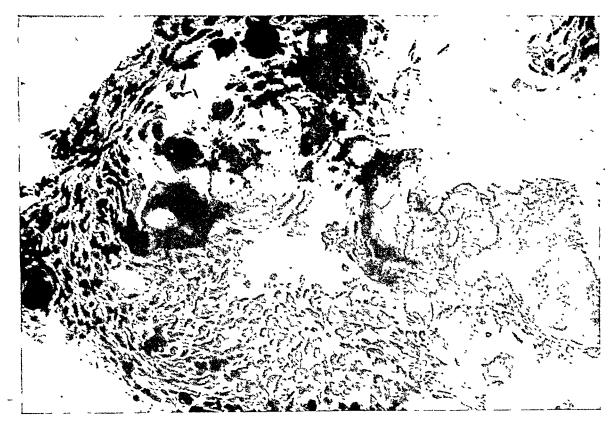


Fig. 3. Smear of aspirated material from superior maxilla showing osteogenic sarcoma. Case XI.

obtained at aspiration confirmed this diagnosis.

Case xx. P. Z. A white female of fifty-one years was admitted to Memorial Hospital April 4, 1930. The history started after an attack of influenza two years previously with pain in the right elbow which extended up into the shaft of the humerus. Four months before admission pain appeared in the neck and later in the ninth and tenth ribs anteriorly. Subsequent swellings appeared over right zygoma, right clavicle and third rib anteriorly.

Examination showed a poorly nourished female in great distress with generalized pains. There was external evidence of tumors over the areas mentioned in the x-ray report.

areas mentioned in the x-ray report.

X-ray Study of Skeleton: "Bone destruction in left frontal and parietal bones, distal end of right clavicle, sixth left rib anteriorly and right zygoma."

The tumor of the right zygoma was aspirated and a diagnosis of blood and fibrin was made. Two weeks later the sixth left rib was aspirated and a report of malignant tumor, unclassified, was made.

the history the diagnosis was plasma cell myeloma.

For those who have not read the article by Martin and Ellis on Biopsy By Needle Puncture and Aspiration, we quote the following:

Technique: The special paraphernalia required is an ordinary 18-gauge needle 5 to 10 cm. in length (which should be new and sharp) and a 20 c.c. Record syringe. For the preservation of the specimen glass slides and a specimen bottle with 10 per cent formalin are needed.

The skin at the site of the intended puncture is painted with iodine and a small area of skin infiltrated with I per cent novocaine. With a bistoury pointed scalpel (No. II Bard Parker blade) a stab wound is made through the skin with the instrument held at right angles to the skin surface. This puncture of the skin facilitates insertion of the needle. An I8-gauge needle attached to a tightly fitting Record syringe is then inserted and advanced slowly through the superficial tissues until the point is felt to enter the suspected neoplastic mass. Guided by

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palpation with the disengaged hand, it is striking how readily a difference in consistence of the tissues can be felt as the needle enters a will be suddenly drawn and splashed over the interior of the syringe, making its collection difficult. While the needle is being advanced

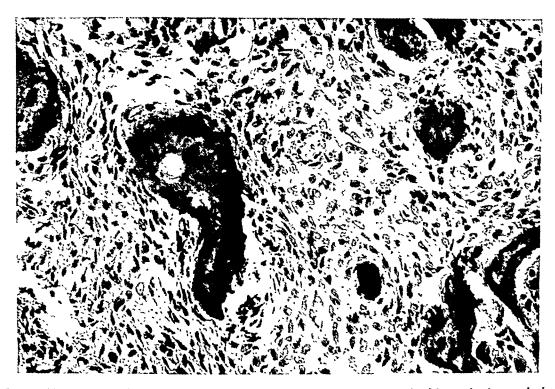


Fig. 4. Biopsy preparation showing histological similarity to preparation obtained by aspiration method.

mass of neoplasm. When the point of the needle is felt to enter the tumor, the piston of the syringe is partly withdrawn so as to produce a vacuum and the needle slowly advanced 1 to 3 cm., depending on the anatomy and size of the tumor. Maintaining the vacuum, the needle is then withdrawn to the same distance and advanced again. This manipulation may be repeated two or three times at the discretion of the operator, care being taken to maintain the vacuum when the needle is advanced or partly withdrawn. Aspiration with the needle at rest is not sufficient to draw tissue into the needle in most cases. By advancing the needle and aspirating simultaneously, a plug of tissue is both forced and drawn into the needle. Maintaining suction during partial withdrawal detaches the plug of tissue already within the needle. We have found this detail to be very essential. Before the needle is completely withdrawn from the tissue, the piston must be slowly released until the pressure in the needle is equalized, or better still, the syringe detached and the needle withdrawn separately, otherwise the aspirated material

and withdrawn under negative pressure, a small quantity of blood mixed with fragments of tissue may enter the syringe, or a solid cylindrical mass of tissue may appear. In other cases, especially in the firmer masses, the syringe apparently remains empty, but after withdrawal, the needle is usually found to contain a plug of tissue.

After complete withdrawal of the apparatus, the syringe is detached from the needle, filled with air, attached and the contents of the needle slowly and carefully expelled on a glass slide. A small fragment of tissue should be left on the slide for smearing, and the remainder placed in the specimen bottle for fixation and staining by regular methods. If the needle is empty, small masses of tissue can almost always be found mixed with blood in the syringe, and these should, if necessary, be very carefully searched for. One or two of these small masses can readily be fished out upon a glass slide for smearing and immediate staining. In any case where the syringe contains blood or any tissue, formalin from the specimen bottle

is poured into the open barrel of the syringe, agitated and returned to the specimen bottle.

8. Mount with Canada balsam and cover glass.

Longer Method. The remainder of the

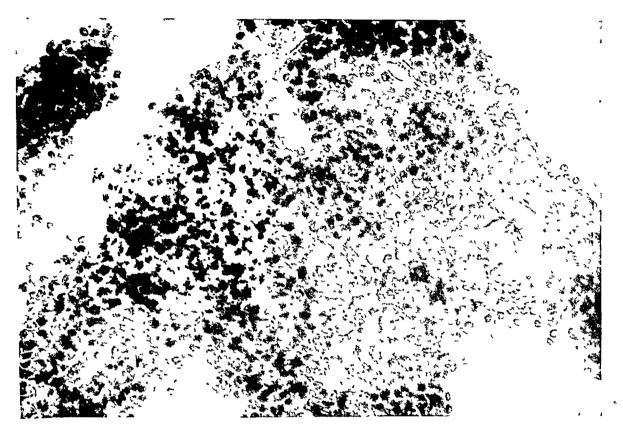


Fig. 5. Smear of aspirated material demonstrating broken down endothelial myeloma. Case XIII.

LABORATORY TECHNIQUE

In the preparation of the specimen for study we have followed the technique described by Martin and Ellis and quote in full as follows:

Preparation of the Specimen. In the average case, we have examined the material obtained by two methods: The shorter (a technique devised by one of us (E) has the advantage of a reading in six to eight minutes and the longer, the advantage of a fixed and cleared preparation.

The Immediate Method. The fresh tissue fragment on the glass slide is smeared by very firm flat pressure by another slide drawn once across. The smeared slide is fixed by heating gently over a gas flame until warm and dry, and is then prepared according to the following technique:

- 1. Alcohol (95 per cent)—one minute.
- 2. Water—one minute.
- 3. Hæmatoxylin—one minute.
- 4. Water—one minute.
- 5. Eosin—one minute.
- 6. Alcohol (95 per cent)—one-half minute.
- 7. Carbolxylol—one-half minute.

specimen is treated as any small biopsy, being carried through the stages of alcohol fixation and embedding in paraffin, great care being taken to collect and mass every minute particle of tissue, since a positive diagnosis may often be obtained from the smallest fragment. Absolutely fresh 52° - 56°c. paraffin should be used for embedding, and all particles massed together on the blook and cooled immediately on ice. Every section cut from the block should be examined for fear that in dealing with such small particles, one might lose the opportunity of making a positive diagnosis. We usually cut six to eight sections and place them on a single slide. These are carefully examined and further sections cut if the first are negative and more material remains on the block.

In case a reading is desired earlier than by our routine laboratory technique, we use the following method of preparation which requires about three hours:

The quick paraffin method:

- 1. Formalin 10 per cent—ten minutes.
- 2. Alcohol 95 per cent—two changes, ten minutes each.
 - 3. Xylol—two changes, one-half hour each.

4. Parassin 54°c.—two changes, one-half hour each. (First three steps in incubator 37°c.)

5. Cut and stain.

operation or biopsy was the original aspiration diagnosis found to be in error. This method is described with due appre-

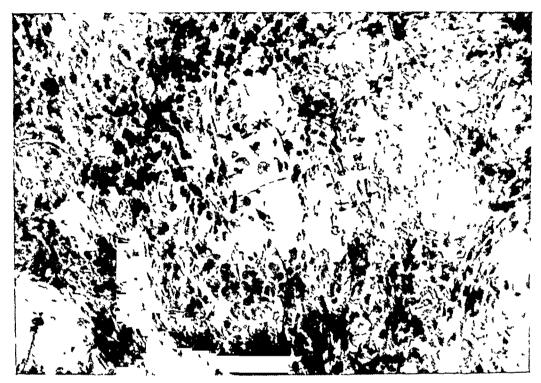


Fig. 6. Aspiration smear reported as mulignant tumor, unclassified. Subsequent biopsy was similarly reported. Case XXII.

CONCLUSIONS

Biopsy by the aspiration method is of value in establishing the diagnosis of bone tumors. It has advantages over the operative biopsy, but in our opinion will never completely displace it. In those cases in which the diagnosis cannot be made, even after several attempts, by the aspiration method, recourse can always be had to an operative biopsy. In those cases in which the pathologist is unable to differentiate the exact type of tumor present, it is of advantage to know whether the condition is neoplastic or inflammatory, malignant or benign. In only 1 case out of the 35 was the pathologist unable to make a diagnosis and in only 2 cases out of 16 which were subsequently checked by paraffin sections of tissue removed at

ciation of the dangers that may be inherent in its general adoption. The possibilities of error, the necessity for selection of cases for its use, and the unusual demands placed upon the pathologist is reaching conclusions from a study of such a small amount of tissue should be borne in mind. The latter consideration is the one which is most likely to limit its field of usefulness.

Finally, the writers wish to express their appreciation of the assistance given by the Pathological Department, Dr. Jamts Ewing, Director, and by Dr. Fred Steware, upon whom devolved the difficult task of making most of the diagnoses from aspirated material; and to acknowledge their indebtedness to Dr. Martin at whose suggestion this work was commenced and who was personally responsible for a number of the aspirations.

THE "ZIPPER STITCH" FOR UPPER ABDOMINAL INCISIONS*

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NEW YORK

HAVE been asked to record a stitch which often facilitates closure of the deep layer in upper abdominal incisions.

deep layer with a knuckle of intestine projecting between the edges. Under these conditions the patient should be taken to

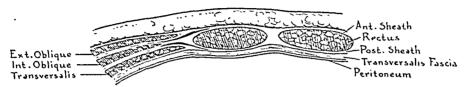


Fig. 1. Posterior sheath of rectus (after Deaver).

It is such a simple procedure that I had not thought it worthy of emphasis. Perhaps, too, it is not original. However, I shall describe it, since it often avoids trouble and is not generally known.

The posterior sheath of the rectus muscle above the semilunar line in made up of fibers from the aponeuroses of the internal oblique and transversalis muscles. These are so intimately fused that they constitute a single layer; and in close apposition to this layer are the transversalis fascia and the peritoneum (Fig. 1). In closure of a vertical incision through the rectus muscle the original suture is not of the peritoneum alone but of these combined structures. They are often tense, retracted and under tension. As a result, apposition of the edges is often difficult; moreover the sutures not infrequently tear out when the sutures are drawn snug or subsequently as the result of distention or straining. The failure of this layer to hold is the usual cause of the large percentage of incisional herniae in these incisions and the occasional occurrence of evisceration. When this distressing complication threatens, the patient complains of discomfort in the region of the wound and vomiting. Inspection of the wound may be negative or show a fullness; separation of the skin edges results in a considerable flow of salmon colored fluid. This, in my experience, always indicates a separation of the

the operating room, the wound opened and resutured. If this is not done distention and straining follow and evisceration is likely to occur.

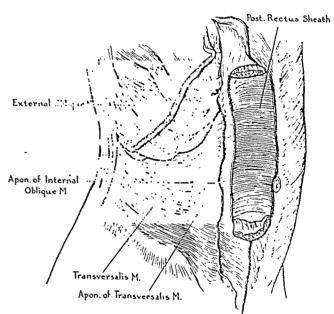
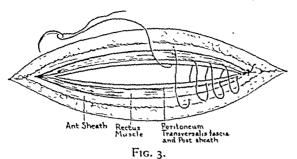


Fig. 2. Posterior sheath of rectus (after Deaver).

The anatomical structure of the posterior sheath is largely responsible for the ease with which this layer tears apart. The fibers of the aponeuroses of the internal oblique and transversalis are transverse and therefore offer no support for the sutures (Fig. 2). The layers, including the attached peritoneum, are taut and the muscles, being attached to the costal arch, are pulled outward with each respiratory movement. The widening of the costal

arch pulls the muscles; the aponeuroses are proportionately drawn outward together with the attached peritoneum. The pull is



resisted only by sutures and the deep ones have little support, being placed in tissues whose fibers are parallel to the direction of tension. It is obvious that the strain on this layer must be relieved by sutures placed through more resistant tissues. This is fully appreciated by all surgeons and is accomplished in various ways: for instance, by tension sutures through all layers, or passing the original suture every third or fourth stitch through the rectus and its anterior sheath. But even in these methods it is often difficult to approximate the deep layer.

I have found the following simple modification advantageous.

A double strand of No. 1 catgut is used. It first picks up the anterior sheath below the lower angle of wound. Having been tied the needle is passed through the rectus and posterior sheath including

peritoneum. It is then passed back and forth from one edge of posterior sheath to the other 3 or 4 times and left very loose.

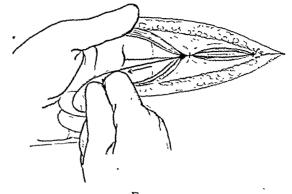


Fig. 4.

This is the important feature. It is then passed forward through rectus and anterior sheath across wound and inward through the opposite anterior sheath, rectus, posterior sheath and peritoneum (Fig. 3). Then the suture is slowly and forcibly pulled taut. The pull should be at a low level and in the direction of the incision, not at an angle. The strain is taken up by the resistant tissues of the anterior sheath, and the posterior sheath and peritoneum come together without strain (Fig. 4). The procedure may be termed the "zipper stitch." The suture may be continued with the same stitch, but in a very tense wall it is best to interrupt it. In this case the suture is passed out again and picking up the opposite side of anterior sheath is tied.



ACUTE GASTRO-MESENTERIC ILEUS*

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NEW YORK

CUTE gastro-mesenteric ileus, frequently referred to as acute dilatation of the stomach, is a form of obstruction caused by compression of the duodenum between the spine and aorta posteriorly and the mesenteric root anteriorly and results in dilatation of the stomach and the proximal portion of the duodenum.

The condition has been repeatedly described, but the symptoms are frequently overlooked, or their gravity is not appreciated.

Many lives will be saved by early

diagnosis and adequate treatment.

Acute dilatation of the stomach was described by Duplay, a French writer, in 1833.

The mechanism of acute gastro-mesenteric ileus was recognized by Rokitansky

in 1842.

Miller and Humby published the first case in the English literature in 1853.

Association with acute infectious diseases was observed by Baugerer in 1855, with injuries, by Erdmann in 1868, and complicating the post-partum state, by Kundrat, in 1801.

Analyses of case reports were made by Conner in 1906, Laffer in 1908 and Doolin in 1918.

INCIDENCE

The majority occur between the ages of twenty and thirty but no age is exempt. In Laffer's series, (11- cases) the extremes were nine months and seventy-five years.

It is slightly more prevalent among women than in men.

It may complicate operations, injuries, and acute or wasting diseases, as may be seen by the following statistics of 131 cases.

Following trauma	17
After operation upon the stomach	4
Upon the bile tract	1.4

Upon the kidneys	ΙĮ
Upon the appendix	5
Upon the uterus	4
Curettage	4
Ovariotomy	4
Herniotomy	4
Other abdominal operations	9
Upon the extremities	11
During the Progress of Disease:	
Pneumonia	6
Appendicitis	4
Carcinoma of esophagus	3
Abscess of Jaw	3
Localized tuberculosis	2
Miliary tuberculosis	2
Brain diseases	3
Spinal deformities (5 after application of plaster	•
iackets)	11
During Convalescence:	
From typhoid	5
Acute rheumatism	2
Scarlet fever	I
Floating kidney	I

Miscellaneous conditions include errors in diet, charged drinks, inflating the stomach for diagnostic purposes and childbirth (Conner).

ETIOLOGY

Opinions differ as to whether the primary lesion is in the stomach or duodenum, but it is agreed that the distended stomach increases the incarceration of the duodenum and that gastric dilation may occur without involvement of the lower duodenal segment.

Paralysis from disturbance of innervation has been described and it has been shown that section of the vagi causes acute dilatation of the stomach in dogs, (Sheeds and Koenniche).

Postoperative intestinal paralysis has been studied by Cannon and Murphy who demonstrated the following:

Etherization for one-half to one and one-half hours and exposure of the intestines to the air, with unusual cooling, did not markedly impair the motor function of the stomach.

^{*} From the Department of Gastro-enterology, Polyclinic Medical School and Hospital.

Submitted for publication, Dec. 15, 1930.

Handling the intestines caused definite delay. Even manipulation within the peritoneal cavity under warm salt solu-

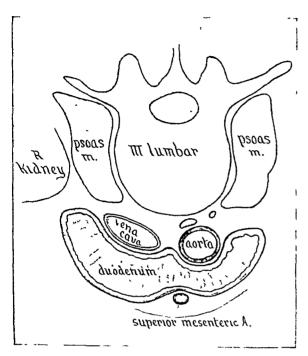


Fig. 1. Isthmus of duodenum. (Reproduced from Author's paper in Surg. Gynec. Obst., Feb. 1918, with permission of publishers.)

tion checked gastric peristalsis for three hours.

Fingering gently in the air caused greater retardation and after rough handling in the air, no food passed the pylorus for four hours and then emerged slowly.

Riedel describes acute dilatation due to serous infiltration of the stomach wall causing muscular weakness.

Kelling describes a valve-like closure of the cardia which is opened by contraction of muscle fibers extending from the esophagus into the fundus and believes that weakening of these fibers or increase in intragastric pressure which maintains the closure of the cardia, makes it difficult for regurgitation into the esophagus to occur.

He maintains that closure of the cardia and obstruction in the duodenum are both required for dilatation to take place.

The dual lesions undoubtedly favor acute dilatation but, that a double obstruc-

tion is not essential is shown by cases with persistent vomiting from the onset.

Both Albrecht and Glénard have described the normal compression of the duodenum between the spine and mesenteric root (the isthmus of the duodenum) and the former demonstrated, upon the cadaver, that traction, downward and backward, upon the mesenteric root converts the constriction into complete obstruction.

Confirming this, Conner's experiments are instructive; with the body of a cadaver in the dorsal position, the small intestines were removed and a cord was attached to the mesenteric root and passed out of the anus and to it weights were attached.

The stomach and duodenum were filled with water through a tube introduced by way of the esophagus and the pressure required to overcome the duodenal compression was estimated by connecting the tube to a mercury manometer.

In several instances a load of 500 gm., the approximate weight of the empty small intestine, caused sufficient obstruction to require a water pressure of 20 to 48 mm. of mercury to overcome it.

In fleshy individuals, Miller found that it was difficult to produce obstruction until the fat had been removed from round the mesenteric root.

From these experiments, it is concluded that prolapse of the small intestine into the pelvis may, under favorable conditions, produce mesenteric compression. It seems obvious, however, that if the prolapse is sufficient to permit the intestines to rest upon the pelvic floor, compression will not occur.

Among predisposing causes are relaxation of the abdominal walls, ptosis of the viscera, a low position of the third duodenal segment bringing it into relation with the prominent lumbar vertebrae, chronic duodenal obstruction and lordosis of the lumbar spine.

It is favored by a collapsed condition of the intestine, from fasting and purgation

before operation, and by prolonged dorsal the tissues that surround them so that decubitus.

Primary gastrie dilatation due to dis-

prolapse of the organs to which they are distributed transmits pressure through

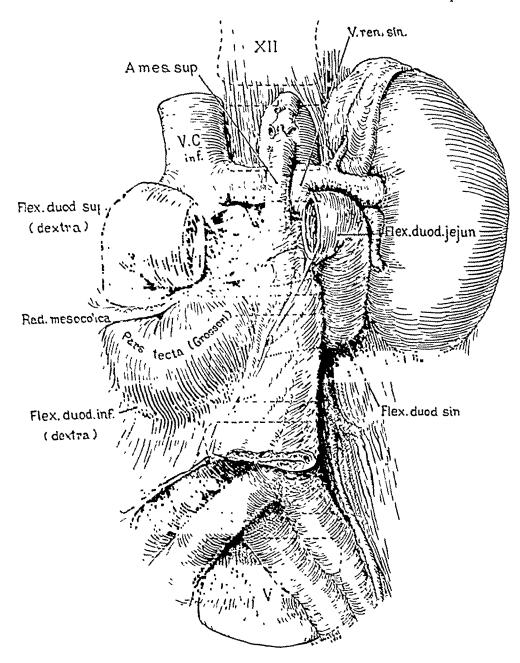


Fig. 2. Relation of duodenum to mesenteric root. (Dissection by Halpert published with permission of Author and of Johns Hopkins Hosp. Bull.)

turbance of innervation or obstructive kinking at the superior duodenal angle is recognized, but in the majority of instances of dilatation with grave symptoms, mesenteric obstruction will be found.

The terminal branches of the superior mesenteric artery supply the small intestine.

The arterial walls are not so elastic as

the superior mesenteric artery to that part of the duodenum which is crossed by the mesenteric root.

PATHOLOGY

The most obvious pathology is the greatly dilated stomach which may appear to fill the abdomen. Its walls are thin or thickened and edematous. The duodenum

is dilated above the point of obstruction. The essential pathology is the compression of the third duodenal segment between the Vomiting occurs in 90 per cent of the cases, but may be a late manifestation, the stomach gradually dilating until the limit

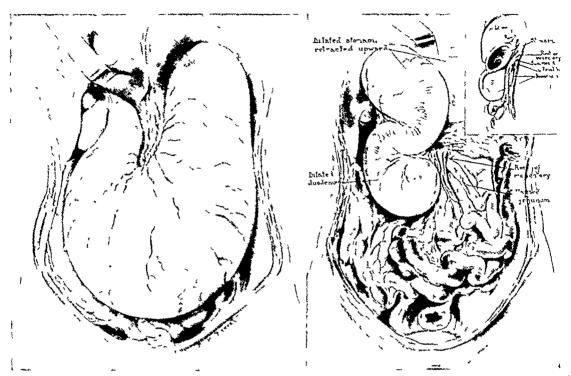


Fig. 3. Dilated stomach due to mesenteric obstruction of duodenum occurring during convalescence from operation for appendicitis.

Fig. 4. Same case. Dilated stomach retracted upward showing obstructed duodenum. (Insert added to show mechanism of obstruction.)

spine and aorta posteriorly and the mesenteric root anteriorly.

The same changes in the stomach may be produced by kinks at the superior and the duodenojejunal angles and occasionally by compression of the jejunum at the pelvic brim when the small intestines are tightly wedged into the pelvis.

SYMPTOMS

General Condition: At first the patient is apathetic and comfortable, the mind is clear, pulse normal or increased in rate and small in volume. Blood pressure is low and temperature is normal or subnormal, unless the condition complicates a febrile state but in the terminal stages the temperature may be high or low.

After a variable period symptoms of collapse occur with clammy skin, anxious expression, delirium or coma.

of distension is reached. In its absence the condition more readily escapes detection.

The characteristic vomiting occurs without straining; the fluid comes up in gulps or seems to run out of the mouth. It is an overflow, a "spilling over" of the distended organ and does not empty the stomach so that a stomach tube, introduced after vomiting reveals the presence of a large quantity, often several quarts, of fluid.

The vomitus is thick or thin and varies in color from yellow or green to almost black.

The odor is foul, cadaverous, but not feculent. A thick dark offensive secretion is characteristic of a serious state. Change to a lighter color, thinner consistency and less offensive odor keeps pace with improved conditions.

The fluid contains bile, pancreatic secretions and sometimes blood. Hydrochloric acid is usually absent.

The quantity of fluid aspirated or vomited greatly exceeds the fluids ingested and may collect so rapidly as to completely

Thirst is often intense due to the loss of body fluids.

Pain may be referred to the epigastric

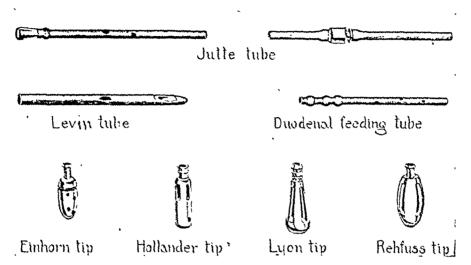


Fig. 5. Types of duodenal tubes in common use.

Those with large tips are adapted to irrigation, bile tract drainage, or aspiration of gastric contents. Levin tube with tip like catheter particularly adapted to aspiration or lavage by transnasal route and is most useful in treatment of gastro-mesenteric ileus.

Jutte tube adapted to irrigation but is not satisfactory for lavage. It may be passed by transnasal route. Its special advantage is that it can be stiffened by introducing a wire within its lumen and passed like a stomach tube. Duodenal feeding tube is most satisfactory for tube treatment of ulcer.

fill the distended stomach within a few hours.

Urinary changes bear a direct relation to the severity of the toxemia: indican, albumin, granular casts, cylindroids, high specific gravity and scanty output are regularly observed.

The blood changes are important.

With the progressive dehydration, there is an increase of hemoglobin and in the number of red cells.

The blood chemistry, as in other forms of high intestinal obstruction, shows decrease in plasma chlorides, increase in CO₂ carrying capacity of the blood, increase in urea and non-protein nitrogen (alkalosis).

These changes are attributed to loss of hydrochloric acid, dehydration and the absorption of a toxic proteose substance formed in the epithelial layer of the duodenum.

Tetany may develop and bears a direct relation to the alkalosis.

Cyanosis, dysphea, eructations and hiccough are occasionally observed. Constipation is the rule, but diarrhea has been noted, or umbilical regions but is not uniformly present and in the writer's experience has been infrequent.

PHYSICAL EXAMINATION

The abdomen is usually distended but may collapse after the stomach has been emptied.

Distension first occurs in the epigastrium but later involves the entire abdomen.

Muscular rigidity and visible peristalsis are infrequent but tenderness about the navel or in the epigastrium is usually observed.

DIAGNOSIS

The diagnosis should not present unusual difficulties although the condition is often overlooked. Frequently when one passes the bed of a patient, a brown or black stain (black vomit) will be observed at the angle of the mouth where regurgitated fluid has soiled the skin. This alone should suggest the possibility of gastro-mesenteric ileus or some other variety of high obstruction.

The characteristic "spilling over" of

gastric contents with an enormous residue revealed by the tube, absence of fever, epigastric distension, relieved by lavage



Fig. 6. Technique of gastric lavage with Levin tube. Patient allowed to drink water freely to facilitate passage of tube. Water removed by aspiration.

and the urinary and blood changes, are characteristic.

DIFFERENTIAL DIAGNOSIS

It may be confused with peritonitis, uremia, acidosis and acute dilatation of the stomach of nervous origin.

With peritonitis there is general tenderness, rigidity, leucocytosis and fever which are lacking in this condition. Gastric succussion, the characteristic vomiting, and the relief of distension after emptying the stomach suggest gastro-mesenteric ileus.

With peritonitis, the epigastrium is the last region to become distended, with gastro-mesenteric ileus, the first.

The blood changes will differentiate it from acidosis.

If attention is first directed to the urinary changes, it may be confused with uremia.

It may be differentiated from acute dilatation of the stomach of nervous origin, by the fact that the latter is a relatively benign condition unless secondary duodenal occlusion occurs. It usually develops early, possibly while the patient is on the operating table.

The distension is chiefly gaseous, and the fluid recovered does not at first present the characteristics of ileus.

PROGNOSIS

In 75 per cent of the fatal cases the duration of the illness is less than five days, the range being from a few hours to sixteen days.

The combined statistics of Conner and Laffer, covering 319 cases, yield a mortality of 67.5 per cent.

Doolin gives the following statistics indicating the comparative mortality under different forms of treatment:

Cases	Deaths	Per Cent
31 treated with drugs	29	93
29 treated by operation	21	72
54 treated by lavage	25	50
30 treated by change of posture	2	7

Death is due to dehydration, alkalosis, toxic nephritis, interference with circulation and respiration, and is attributed to the absorption of metabolic toxines formed in the mucosa of the obstructed duodenum.

Early diagnosis and intelligent treatment will greatly lower the mortality.

TREATMENT

Prophylaxis: Before operation avoid strong catharsis and prolonged fasting.

During operation avoid unnecessary exposure and manipulation of the viscera. Examine for chronic duodenal obstruction and prolapsed small intestines.

After operation avoid prolonged dorsal position, keep on right side as much as possible or on abdomen, if not contraindicated.

If the small intestines are in the pelvis at the time of operation, use Trendelenburg position.

Food and fluids should be given in small quantities at first to avoid distension.

With the onset of digestive discomfort, belching, nausea and regurgitation, aspirate the stomach contents.

Many surgeons feel that lavage after operation subjects the patient to severe

strain, and postpone it until the need is imperative.

It is, however, safer to empty the stomach early and to repeat the procedure frequently if there is a tendency for fluid to collect rapidly.

The stomach tube should be of moderate size and velvet finish. The openings should be placed laterally, near the tip, their combined caliber exceeding that of the lumen, the margins smooth and rounded. The tip should be hollow and soft.

If the patient is not accustomed to lavage, a duodenal tube is preferable.

One is selected with an open end (Levin tube) or with a small tip (Jutte tube), and introduced through the nose while the patient drinks water to carry it down.

It causes little discomfort and as the stomach is to be emptied promptly, the quantity of water need not be limited.

The condition established: The indications are to keep the stomach empty, to restore body fluids, relieve mesenteric compression, combat alkalosis and stimulate peristalsis.

To keep the stomach empty: Discontinue food and fluid by mouth.

Even though the patient appears moribund, introduce a stomach or duodenal tube for a distance of 20 in. to insure reaching the greater curvature of the stomach, which may be at the pelvic brim.

Remove the contents by syphonage or aspiration before washing with normal saline solution, measure the water introduced and recovered to avoid increasing the dilatation.

Repeat the procedure often enough to prevent re-accumulation of toxic products, possibly every three or four hours, day and night, until improvement is shown by diminution in the quantity of secretion, lighter color and less offensive odor. The intervals between treatments are then gradually lengthened.

If frequent aspiration is required, it may be desirable to leave the tube in situ and to

maintain continuous drainage.

Fluids can be given through the tube and can be held in the stomach, by applying a clamp until it is desired to repeat the drainage.

The best time for introducing food and fluid is immediately after the stomach has been emptied.

To restore body fluids: The importance of early and continual replacement of the fluid lost has been demonstrated in experimental ileus (Maury, McLean, Wilkie, Hartwell and Hoguet).

Normal saline solution is introduced by rectum, intravenously and subcutaneously.

To relieve mesenteric compression: An abdominal binder is applied with a pad above the pubes, the foot of the bed is elevated and the patient is turned upon the abdomen, or in suitable cases, a knee-chest position is assumed, with the abdomen supported by pillows. These measures tend to relieve the downward drag of the distended stomach and prolapsed small intestines and the stomach is more readily evacuated.

A procedure, recommended by Conden, reverses the position of the bed and forces the small intestines upward by filling the pelvis with Ringer's solution, introduced by needle puncture of the abdomen. The addition of glucose prolongs the effect by delaying absorption (Ringer's solutionsodium chloride, 0.7 per cent; potassium chloride 0.03 per cent; calcium chloride 0.02 per cent, 2500 c.c., and glucose solution 500 c.c.).

To combat alkalosis: Sodium chloride is selected because it can be administered freely by all the avenues of absorption and in suitable cases may be supplemented by using dilute hydrochloric acid.

Bicarbonate of soda is contraindicated in all cases with a tendency to alkalosis and should be avoided until the blood chemistry changes have been determined for there is clinical and experimental evidence of its toxic effect.

To stimulate peristalsis: Eserine salicylate is useful but is a circulatory depressant. Pituitrin is somewhat less effective.

Eserine salicylate grain 1/40 hypodermatically and a croton oil enema (croton oil, 2 drops, castor oil, olive oil, glycerine, 2 oz. each) may prove a useful combination.

An enema of 6 per cent salt solution may also be effective. It stimulates peristalsis powerfully, preceded by antiperistalsis (Kelling).

There is little indication for other remedies although atropine, warm compresses, turpentine stoups and strychnine have been recommended.

When fluids are resumed by mouth, advantage may be taken of the fact that weak alcohol solution is more rapidly absorbed than plain water and that carbohydrates leave the stomach more rapidly than fats or proteins.

Operative Treatment: Operative results are not encouraging. The procedures have consisted of gastrotomy, gastrostomy, gastroenerostomy, jejunostomy, and exploratory laparotomy.

The mortality of 72 per cent (Doolin) will deter one from operating when the

combination of lavage, change of posture, and the combating of dehydration and alkalosis yield a mortality of about 7 per cent.

SUMMARY

Acute gastro-mesenteric ileus is the cause of death in numerous medical and surgical conditions. The essential pathology is the compression of the lower duodenal segment by the mesenteric root. The clinical manifestations consist of marked dilatation of the stomach, the accumulation of toxic fluids in the stomach, greatly in excess of the fluid ingested, dehydration, toxic nephritis and a tendency toward alkalosis.

The treatment should consist of frequent evacuation of the stomach, postural changes to lessen the compression of the duodenum, and the introduction of large quantities of saline solution to combat dehydration and alkalosis.

The use of alkalies and surgical intervention is contraindicated.

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THE TREATMENT OF

CONGENITAL DISLOCATION AT THE HIP-JOINT*

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HE treatment of congenital dislocation at the hip joint was seldom attempted until Paci, in 1888, presented his method of closed reduction. At about the same time the open operation was performed; but, on account of poor surgical technique, there were frequent bad results and the method came into disrepute. The closed reduction was not very satisfactory at first, but with Lorenz's modification of the Paci method better results were obtained and a new stimulus was given to the treatment of this deformity. With the introduction of Hoffa's improved open operation that form of treatment received a number of adherents. The closed method proved to be the most popular; but with an ever increasing demand for better results and a considerable number of failures, not a few investigations have condemned the closed method. Because of these adverse experiences there has recently been a tendency to revert to the open method of reduction which, on account of the perfection of surgical technique, has been freed from many of its dangers. However it behooves us to reserve our final decision until more convincing evidence is presented to show its advantage over the closed treatment. In this report both methods will be considered and data presented which it is hoped may be helpful, when added to the increasing statistics, to aid in determining the indication for one or the other type of treatment.

In 1922 Denuce, of France, published a short article in which he reported that he had performed, without a fatality or immediate complication, 1300 closed reductions for congenital dislocation at the hipjoint. His results show no fractures or separations of the head and no injuries to

the epiphysis, nerves, vessels or skin. There were only 12 reluxations, 10 of which were subsequently successfully reduced. This high standard had not been approached before. The majority of reports show anywhere from 50 to 85 per cent of successful results. Careful manipulation and meticulous attention to detail in the post-reduction treatment are responsible for this success.

In writing of his method Denuce points out as the most important thing to observe, the suppression of all force and the avoidance of any trauma of the cartilage, bone or soft parts. If he failed in his first effort he put the patient to bed and applied traction up to 8 kg. on the dislocated side. He never broke down the muscle tissue and if it needed special treatment he massaged it with a movement parallel to the muscle fibers. Thus he differed from most other operators and especially from Lorenz who often uses extreme force in the reduction and even uses the head as a reamer to deepen the acetabulum.

Denuce placed the age limit for a double reduction at eight years and for a single reduction at eleven years. He attempted manipulation in the older children if the individual was not greatly developed and weak muscularly, and then only at the express wish of the parents.

In the after care he carefully carried out the following procedures: At the end of six months the plaster was bivalved. With the patient in half of the shell extension of the knee-joint and rotation were gradually performed. Exercises were given for the gluteus maximus. At the end of about three weeks the leg was brought up to the straight position and the child allowed to sit up. Heat in the form of hot sand bags was

^{*}From the Shriner's Hospital for Crippled Children, San Francisco. Submitted for publication November 28, 1930.

applied to the hips and extremities for an hour at a time. Later salt baths were given in which 1 kg. of salt was added to 10

a successful result. After all there is a definite personal element in all conclusions. One might ask how critically he interpreted



Fig. 1. Right hip after reduction. Excellent function. Some flattening of head and changes in neck of femur.

I. of water, this being sufficient salt in which to float the patient. Heliotherapy to tan the skin and for its secondary effect on the bones was then given. The period of half immobilization lasted from one to four months or until the child had recovered a good part of his mobility, until there was an increase in calcification of the bone and the form of the epiphysis approached the normal. The patient was then allowed to walk a little, the described treatment being carried out all of the time.

If other operators could approach the standard set by Denuce there would be no need to look further for a method of reduction for congenital dislocation at the hipjoint. Unfortunately there are few who are willing to desist from frequent and forceful attempts to reduce the dislocation, and there are, likewise, few who have the patience to carry out the slow, painstaking program of post-reduction care described by Denuce. It is, therefore, unlikely that many will attain an equally high degree of perfection.

I have always been interested to know what Denuce set as his standard for judging



Fig. 2. Three years after reduction for left dislocation. Excellent function. Head of femur higher than normal and acetabulum rather shallow.

the results of his cases, how long he kept them under observation after the treatment was completed, how much motion he considered necessary to success, whether there was always a normal gait following reduction, whether the position of the extremities was normal, whether the head of the femur showed changes in later life and whether arthritic changes and manifestations appeared. It is seldom that one sees films made after a supposedly successful reduction which do not show changes, especially in the form of the head and the tendency toward upward migration. It seems strange that in none of the cases described by Denuce did extreme anteversion or antetortion exist to preclude the possibility of a successful reduction. Neither were there any cases of hourglass capsules, shallow acetabulums, marked muscle contractions or contracted cotyloid ligamentus impediment to prevent reduction or cause redislocation. But regardless of the exactness of the report on the finished results one must marvel that anyone could obtain such success in reducing 99.8 per cent of the treated cases using the closed method of correction.

A brief review of some of the other reports on this subject may be interesting

for comparison with those submitted by Denuce.

Soutter and Lovett² in 1924 reported the



Fig. 3. Result after bilateral open reduction with shelf and bilateral femoral osteotomies. In this patient primary closed reduction was performed but at age of four years luxation took place on both sides. Final result only fairly good. Both femurs are high with changes in head and neck.

results of 277 cases of congenital dislocation at the hip-joint that were treated at the Children's Hospital in Boston between the years of 1912 and 1920. At least two and a half years had elapsed after each reduction before results were taken. Their summing up shows 71 per cent of successful results. In 40 per cent of the 35 per cent that required reoperation, segmentation of the head occurred. There were 2 cases of peroneal paralysis and 3 cases of fracture of the femur.

Farrel, Von Lackum, and Smith³ reported the results of 366 cases which were treated at the New York Orthopedic Hospital between the years of 1900 and 1920. In only 41 per cent of their cases had the head of the femur remained in the acetabulum with a good functional result. Five per cent could not be reduced at all. These operators believe that anteversion plays an important part in redislocation. Where anteversion was over 50°, only 30 per cent of the results were successful. These men often bring out the point that

they often failed to correct anteversion by osteotomy. In only 7 cases did they find perfect anatomical results as determined

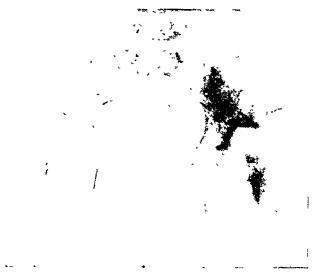


Fig. 4. Open reduction with shelf for right dislocation. Opposite hip to be reduced by open operation if good function is obtained on right side.

by comparing the roentgenograms of the normal with those of the operated sides. However, an abnormal condition appearing in the roentgenographic pictures did not indicate necessarily a poor functional result.

Galloway,⁴ who is a great advocator of open operation, states that he was driven to the open method of reduction by the distracting uncertainty and frequent failure which attended his former efforts with the manipulative cure. He practices the operative treatment on even the very young and reports excellent results.

De Forest Willard⁵ reported in 1926 the results of 26 reductions by the Davis method. These cases had been treated at least a year before the report was made. There were 60 per cent with good results and 30 per cent with instability. Ten per cent were failures. He believes the poor results are caused by too much trauma resulting from manipulation, too early weight-bearing and tardy reduction.

Chatterton and Flagstad⁶ in 1925 reported on 182 treated cases with 87 per cent reductions and 75 per cent of good results a gradual higher percentage being obtained in the more recent cases.

Putti reported in 1926 the results of a series of 2500 cases of reduction of both single and bilateral congenital dislocation of the hip-joint. He used the Paci method and obtained success in 90 per cent of the single and 65 per cent of the bilateral cases. Five per cent of the whole number could not be reduced. This operator places as his age limit seven years for the single and four years for the bilateral attempted reduction. Open operations are performed only when the closed method fails or when the age limit has been exceeded. In a recent article Putti advises early reduction, even during the first year. At this early age it is sufficient in many cases to put the legs in forced abduction on a specially devised frame. To judge from the reproductions of the films taken of some of the infants treated by Putti it appears that in certain cases the results were merely subluxations.

Elys in 1925 reported that about 55 per cent of his series of 28 cases were successful. He used the Lorenz method of treatment with open operation if necessary.

In 1921 Ridlon⁹ published a paper in which he cited the lessons gained from his personal experience with cases of congenital dislocation at the hip-joint. He stated that after a number of fractures of the femur and general bad results with the Lorenz method he devised a treatment of his own. According to his method, while the thigh is fully flexed an endeavor is made to lift the upper end of the femur, keeping the fingers at the back and the thumbs in front to feel the head as it slips forward into the socket. Over a period of fifteen years his results show an improvement of from 60 per cent of successful reductions in 1905 to 80 per cent in 1920. Ridlon had the opportunity to follow personally a number of cases treated by Lorenz in 1902 and 1903 and reports that many of the supposedly successful reductions proved to be failures. Ridlon reported in his article another interesting fact, namely, that A. H. Ferguson in 1900 turned down a shelf from the side of the ilium to support a dislocated

hip. Recently, under the name of the Dickson operation: the same procedure has been recommended for irreducible dislocation of the hip.

Stephens¹⁰ in 1928 reviewed the results of 222 cases treated at the Hospital for the Ruptured and Crippled in New York. He found that the anatomical and functional cures were obtained in only 15 per cent of the cases treated.

It is plain then, to judge from the varying results obtained by these operators, that there is a strong personal element involved in the interpretation of the meaning of a successful reduction of congenital dislocation at the hip-joint. The standard by which a finished reduction is judged, depends, to a great extent, upon the degree of perfection which is considered necessary to success and upon the different emphasis placed, by each operator, upon the various factors in summing up the results. The most important of these factors are the range of motion and the variations in gait, the resultant manifestations in later life and the roentgenographic study of the preoperative and postoperative pictures.

For example, each operator may have a different standard by which he judges a successful functional result; one may place utmost importance in the variations in gait while another may overlook this in favor of the resultant range of motion. One may draw his conclusions shortly after correction while another may keep in touch with the patients for several years after operation and take later changes into consideration in tabulating his findings. Likewise, in studying the roentgenograms there are many chances for variation especially in the interpretation of the pictures themselves. Shortly after reduction there may be an apparently perfect result but with the lapse of time changes may occur in the shape of the head and acetabulum with subsequent reluxation. Thus we realize that there are many interesting factors and varying combinations of factors which influence the statistics in each group of cases.

But in spite of the personal element which is largely responsible for the discrepancy in the findings, it is safe to say that certain methods of reduction offer greater possibilities for success than others. It is noted that the methods of Denuce and Davis, because of the better results obtained by them, are gradually replacing the Paci procedure which was modified and practiced by Lorenz. Following is a résumé of the Denuce and Davis operations, of the methods which are used to treat various complications following reduction and of the open operation which is used to correct cases of irreducible dislocations and any other cases which do not yield successfully to less radical forms of treatment.

The Denuce Method: The anesthetized patient is placed on his back, after which the thigh is flexed at the hip-joint while the knee is in flexion. The thigh is gradually abducted, this being made possible by gently massaging the abductors. After full abduction is obtained the knee is then carried across the body until it points in the direction of the opposite axilla. Downward pressure is then made on the knee and by a movement of circumduction the extremity is brought down while at the same time the fingers placed under the head of the femur make upward pressure in the direction of the acetabulum into which the head is directed. If the reduction is successful the leg is maintained in the position of 90° abduction and 90° flexion by a single or double plaster hip spica which extends to the ankles. The time for the change of plaster depends upon the stability of the hip immediately after reduction. If there is a tendency toward easy redislocation the hip is maintained in the primary position for a longer period to allow for greater adaptive changes between the head and the acetabulum. The usual time for changing the plaster is at the end of the third month and again about every six or eight weeks. Particular attention is exerted to secure internal rotation as the leg is brought down. At the end of about nine months the extremity should be in the normal extended

position, at which time physiotherapy and exercises are put into effect. As soon as the muscles regain their tone the patient begins to walk with support which is gradually abandoned.

Davis Method: The patient is placed face down on the table. The extremity is flexed at the knee and then brought up beside the chest. The operator holds the knee with one hand and forces it slowly up from the table while at the same time, with a series of pump-handle motions, he brings the thigh away from the body. While executing this maneuver he creates, with the other hand, strong downward pressure on the great trochanter to force the head forward into the acetabulum. Following the reduction the usual post-reduction treatment is followed.

In some cases the head of the femur will remain in the acetabulum only when the limb is internally rotated and will redislocate as the neutral position is approached. In this event, whether due to anteversion or antetorsion, it is necessary to perform an osteotomy of the femur. The lower fragment is externally rotated to give an internal thrust of the head into the acetabulum as the leg assumes the neutral position. The Sherman method of operation may be used. In this case a long nail or pin is driven through the great trochanter into the neck, a considerable portion of the pin being allowed to project beyond the skin. A subtrochanteric osteotomy is then performed and as the pin holds the upper fragment the lower is rotated to the desired degree. The new relation of the fragments is maintained by incorporating the projecting portion of the pin in the plaster spica. Hibbs performs an osteotomy above the condyles of the femur and rotates the distal fragments outward.

In other cases a fixed external and flexion deformity may persist after reduction. This condition is treated by a modified Soutter fasciotomy and an osteotomy with internal rotation of the lower fragment.

After an apparently successful reduction the head may gradually become displaced out of the acetabulum. It has been found that an open operation and the insertion of a shelf at the margin of the acetabulum will insure a very good result. In case ankylosis occurs after reduction an arthroplasty may be performed at the end of the growing period.

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If it is found impossible to reduce a dislocation by the closed method open operation is performed after a preliminary stretching of the leg muscles by traction. The capsule is exposed by a Smith-Petersen incision, is opened and the acetabulum is located. The head of the femur is then reduced into the acetabulum, a bone skid being used in difficult cases. The capsule is reefed and closed. If the acetabulum is shallow a shelf is made at its margin. It is really advisable to make a shelf in all cases to prevent subsequent displacements.

Primary open operation is indicated in older children where the closed method would result in a great amount of trauma. If, in an open operation, it is found impossible to place the head into the acetabulum a shelf can be built above the head after it is pulled down as far as possible.

Allison 11 has reduced some very resistant cases by first freeing the upper end of the femur and at the same time performing an osteotomy of the lesser trochanter. Skeletal traction is applied after which the head is reduced by a second open operation.

Swett¹² reported the results of an operation in which he performed a transverse osteotomy of the upper end of the femur. after which he severed the muscle attachments to the trochanter and reduced the dislocated head into the acetabulum.

Grove¹³ succeeded in reducing a difficult dislocation after the resection of about 2 in. from the shaft of the femur.

Lorenz¹⁴ recommends the bifurcation operation in which an oblique subtrochanteric osteotomy is performed and the upper end of the lower fragment is projected into the acetabulum.

The following report is a summary of the results of 50 cases of congenital dislocation

at the hip-joint which were treated at the Shriner's Hospital for Crippled Children in San Francisco. The majority of these cases were kept under observation for from three to five years following treatment:

There were 31 (62 per cent) in which reduction was obtained by using the closed method of treatment. In 12 of these it was necessary to perform a secondary operation because of a persistent deformity or a tendency to subluxation. In practically every case in which an open operation was performed the margin of the acetabulum was reinforced by a shelf thrown down from the side of the ilium.

Four cases (8 per cent) which were irreducible by the closed method were successfully treated by open operation.

In 5 cases (10 per cent) primary open operation was performed because this procedure indicated better results than the closed method.

In 2 cases (4 per cent) the head of the femur was not placed in the acetabulum but was pulled down as far as possible and held in place by a shelf of bone turned out from the ilium.

In 8 cases (16 per cent), in which reduction by the closed method failed, no further treatment was rendered.

It is very difficult to tabulate accurately the final results. The rather elastic classification in which the terms excellent, good, fair or poor, while subject to criticism, is about as useful as any for calculating comparative results.

In the group of cases studied there were:

Excellent: 6, or 12 per cent

Good: 20, or 48 per cent Fair: 7, or 14 per cent

Poor or Failures: 8, or 16 per cent.

It is interesting to note that only 10 of the 50 cases were under four years of age and a large percentage were bilateral. This relatively high age limit naturally adds to the difficulty of the reduction and lessens the chances of obtaining a good result. In the 8 cases under the heading of poor, or failures, the ages of the children treated were twelve, ten, nine, nine, eight,

eight, five and five years. This is in accord with the results of other operators, which indicates that the treatment of older patients is less satisfactory, especially if the dislocation is bilateral.

Discussion: Whether the open or the closed method of treatment in cases of congenital dislocation at the hip joint is the more satisfactory is a question which remains unanswered. The results obtained by Denuce and Putti, who have had more experience than most other operators, indicate that the closed treatment is, at the very least, successful. But not until someone has had an equal opportunity to accomplish a large series of primary open operations can a comparison of the results be made. Unless results can be obtained which prove that the primary open method is more successful than the closed, primary open operation in all cases is not advisable. In the hands of an experienced and skillful operator with good technique the open operation is easily and safely performed. On the other hand the closed method is, without doubt, easy, safe and satisfactory. In most patients up to five years of age closed reductions by the experienced operator can be performed in a very short time with prospects of a good result. Therefore, until primary open operation can be proved more successful, the present procedure of attempted closed reduction, with open operation in cases of failure, is indicated.

Judging from my own experience I feel

that in young children, up to six years, whether the dislocation is single or double, the closed method of Denuce is satisfactory. If the case can be obtained before the age of three years the reductions should be near 100 per cent. In older children or in young patients where there is abnormal muscle development and other signs of resistance to reduction primary open operation offers the best choice of successful cure.

In all open operations I find it is advisable to reinforce the upper rim of the acetabulum with a shelf of bone. This procedure takes very little longer, can be accomplished during the same operation as the reduction and renders added security against redislocation.

In treating dislocations which are very resistant to reduction even by open operation it may be advisable to utilize some of the enumerated procedures that have been found helpful in this class of difficult cases.

Conclusion: Until there are further definite statistics in favor of primary open operation it is advisable, up to six years of age, to attempt a closed reduction before resorting to open operation. In older children, or in cases where there is evidence of abnormal resistance, open operation has the best chance of a cure. If open operation is performed a shelf can be inserted at the time to insure retention of the head of the femur in the acetabulum.

Early recognition and early treatment will do more to increase successful results than any other measure.

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[For Remainder of References see p. 243.]

FRACTURE OF EXTERNAL SESAMOID BONE AT THE FIRST METATARSOPHALANGEAL JOINT

WITH REPORT OF A CASE*

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CHICAGO, ILL.

R. male, forty-one, colored, laborer, entered Evanston Hospital clinic on February 28, 1930, because of a left

This sesamoid bone is often found, and has no significance. Under the great toe are two sesamoids, the external of which seems to be



Fig. 1.

foot injured when a wheelbarrow full of planks turned over, the planks striking the top of the foot forcibly. Examination showed some swelling on the dorsum of the foot, with tenderness elicited over the plantar surface on the outer, fibular, side of the head of the first metatarsal bone. The history and findings were typical for fracture sesamoid bone, and x-ray showed an oblique division with the following report.

Evanston Hospital, 32113, or Cook County Hospital, 10204, left foot.

"There is an os tibiale externum, commonly known as the sesamoid in the tendon of the tibialis posticus, which is frequently found.



Fig. 2.

divided. The sesamoids are often divided, and when so, are sometimes mistaken for fractures. Of course it is possible for a fracture of the sesamoid to occur, but so often we find it divided, that it is difficult to say whether or not a fracture has occurred. The attending physician will be guided in this case largely by the physical findings at the time of the examination."

There is evidence of osteoarthritis involving the first metatarso-phalangeal joint"—(James T. Case) (Fig. 1).

equently found. According to our article published in *Submitted for publication Dec. 1, 1930.

April, 1929, on sesamoid fractures, few fractures of the external sesamoid bone of the great toe have been reported in the literature, and no cases of congenital division of that bone. Since then Dr. James T. Case has called our attention to 3 cases of congenital division with roentgenograms reported in the German literature. 2,3 As the congenital divisions are usually smooth and transverse or longitudinal, and this division rather oblique and irregular, a diagnosis of fracture was made, and the foot and ankle incorporated in a cast in the proper position. The patient was watched for four weeks, but he continued to complain of pain whenever slight pressure was made on the plantar region over the fibular sesamoid bone. We decided therefore to remove the fractured bone, and did so at Cook County Hospital, on April 3, 1930. The bone removed was split obliquely. As early as ten days after the operation there was no pain or pressure in the same region, which helped to confirm clinically, the diagnosis of

fracture. The removal of the bone gave us the opportunity to confirm the diagnosis again through the pathologic laboratory, which Dr. William Brandes, of Evanston Hospital, did, making sections, reporting as follows:

Sections show dense fibrous tissue and irregular spicules of bone. Several places appear as though there is a gradual transition from dense fibrous tissue to bone. The cells, along the margins of the spicules, arrange themselves in a layer parallel to bone spicules. Between the bony spicules, as in the crevices, there is a less dense network of fibrous tissue. Diagnosis: Dense fibrous tissue showing transition to bone (Fig. 2).

The postoperative cast was removed April 28, 1930, and the patient went back to work, cured, May 5, 1930.

Summary: 1. Although rare, 3 cases of congenital division of the fibular (outer) sesamoid bone of the great toe have been reported in the German literature.

2. Another fracture, also rare, of the fibular sesamoid bone is reported, and the diagnosis of fracture confirmed by: (a) clinical history; (b) roentgenologic findings; (c) operative findings and result; (d) pathologic laboratory examination of the bone histologically.

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^{*}Continued from p. 241.

BUTTON-HOLE RUPTURE OF THE EXTENSOR TENDON OF THE FINGER*

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THE usual injury to the extensor tendon of the fingers is that commonly known as "baseball finger." This



Fig. 1. Button-hole extensor tendon.

injury is due to a tearing of the extensor tendon at its insertion into the base of the first phalanx. Another less common and less easily recognized injury to the extensor tendon is that which has been described as a "button-hole" tearing of the extensor tendon. Its site of occurrence, and the symptoms by which it is manifested are sufficiently characteristic to warrant the report of the following case:

M. C. male, aged seventy, was seen on November 5, 1930, complaining of inability to extend the second phalanx of the fifth right finger. The patient stated that two weeks previously he had accidently struck the dorsum of his finger with the hand partly closed. Though he complained of some pain, he was still able to extend the fifth finger completely. Several days later, and then about one week later the patient again struck his finger at the level of the first interphalangeal joint. It was after this that he first noticed the inability to completely extend the finger at the first interphalangeal joint.

There was complete normal power of flexion of all the fingers, though a peculiar erepitus could be felt over the first interphalangeal joint, when this joint was flexed. Passively,

each of the phalanges could be completely extended, but actively the patient could not extend the second phalanx upon the first. The x-ray showed no evidence of any pathological process in the joint. On attempting to extend the finger from the position of full flexion, the first phalanx extended, the terminal phalanx became hyperextended but the second phalanx remained flexed (Fig. 1). A diagnosis of partial longitudinal rupture or button-hole tearing of the tendon was made and operation undertaken.

At operation through an L-shaped incision the expansion of the extensor tendon over the first phalanx as well as over the second was found perfectly normal. However, beginning slightly above the first interphalangeal joint, and extending to slightly below it there was a definite oval separation of the extensor expanse. Voluntary flexion of the finger upon the operating table demonstrated the lateral gliding of both halves of the extensor tendon and the rising between them of the distal end of the first phalanx. The edges of this button-hole in the extensor expanse were excised and both halves were approximated with interrupted mattress stitches of silk. The joint was not opened. Immediately thereafter while still on the operating table the patient demonstrated to his and our own satisfaction complete restoration of power of extension at the first interphalangeal joint. The skin was closed and the finger dressed in extension on a tongue depressor splint. Convalescence was entirely uneventful, and motion was begun at the end of the fourth week. At the end of twelve weeks, however, the result was not considered entirely satisfactory. Though the patient has not the disability for which he was originally operated and is able to extend the finger to about 135°, there has apparently been some relaxation of the suture-line, with consequent impairment of complete extension.

As in the case of "baseball finger," the diagnosis in these cases is to be made almost on the history and inspection alone.

^{*} From the Hospital for Joint Diseases. Submitted for publication January 14, 1931-

The deformity, flexion of the second phalanx with ability to actively extend the proximal and distal phalanges in the absence of any bone block or interference with flexion, is characteristic and indeed pathognomonic of button-hole tearing of the extensor tendon or rather of partial rupture involving the central portion of the extensor expanse. The explanation of this phenomenon is readily at hand on recollecting the anatomy of the extensor expanse which Gray describes in the following words:

Opposite the metacarpophalangeal articulation each tendon is bound by fasciculi to the collateral ligaments and serves as the dorsal ligament of this joint; after having crossed the joint it spreads out into a broad aponeurosis, which covers the dorsal surface of the first phalanx and is reinforced, in this situation, by the tendons of the interessei and lumbricales. Opposite the first interphalangeal joint this aponeurosis divides into three slips; an intermediate and two collateral; the former is inserted into the base of the second phalanx; and the two collaterals, which are continued onward along the sides of the second phalanx, unite by their contiguous margins, and are inserted into the dorsal surface of the last phalanx.

With the finger flexed, the central portion of this expanse is uppermost and is consequently most liable to injury when

struck against the prominent edge of the head of the first phalanx. As the flexion is continued the head of the first phalanx projects upward between the uninjured lateral portions of the tendon which are displaced to the sides of the first and second phalanges with a slight crepitating sound. Now, when attempts are made to extend the finger, these lateral portions, in the very act of extending the distal phalanx, grip the sides of the interphalangeal joint below its axis of motion like guy ropes and present normal extension. When the finger is relaxed, and the vise-like action of the lateral expanses obviated, no difficulty is experienced in passively effecting complete extension of the finger at all its joints.

On this basis, the indication for therapy is very concise and unequivocal. The rent in the tendon must be sutured. No hope for even partial recovery can be expected from conservative treatment. As the case herewith reported demonstrates, the prognosis must be guarded even if the immediate operative result appears perfect. Doubtless the poor reparative faculties determined by the age of this patient must have played some rôle in the incomplete result obtained. On the other hand, the normally poor blood supply to aponeuroses and tendons generally must be given some consideration in our prognostications.



OSTEOMYELITIS OF GONOCOCCUS ORIGIN IN AN INFANT

REPORT OF A CASE*

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A CASE of osteomyelitis of gonococcus origin is of sufficient rarity to warrant reporting. Such a case,

The father and mother denied having had gonorrhea, by name and symptoms.

When the child was seen at the clinic the



Fig. 1.

in an infant, is a still greater rarity. The infant in question was seen by me while acting as voluntary assistant in the outpatient-department of the Hospital for the Ruptured and Crippled, on February 11, 1930.

The history of the case was as follows: At the age of two weeks the infant became irritable and was noticed to scream with pain whenever the left leg was touched. A swelling appeared on the upper third of the leg which gradually increased in size. Various home remedies were applied, but the swelling continued to increase in size, and the infant was more restless with pain. At no time was a record of the temperature taken. The child continued to nurse well and gained in weight. It was a normal, full-term delivery, having two sisters and one brother alive and well.



Fig. 2.

following conditions were found: A well nourished infant of four weeks, crying lustily. The general examination was completely negative. The umbilicus appeared normal. The local condition presented a fusiform swelling, surrounding the upper third of the left leg, which was red, dense and extremely sensitive to the slightest pressure. It was 3.5 cm. in width.

An x-ray taken the same day was reported by Dr. R. W. Lewis (Fig. 1). Anteroposterior and lateral views of the left leg show periosteal new bone being formed about the shaft of the tibia in its middle third and the lower part of the upper third. There is noted an indefinite area of rarefaction in the metaphysis at the upper extremity of the tibia. There is very marked swelling of the overlying soft tissues especially anteriorly. The upper tibial epiphysis has that annular appearance sometimes found in scurvy, but the epiphyseal line and metaphysis give no indication of scurvy.

A question of scurvy was raised in this case. However the extreme infancy of the patient militated against this diagnosis. The child was again brought to the clinic two days later. The firm mass had become fluctuant. The temperature had risen to 100.5°F. An aspirating needle was inserted into the mass and 5 c.c. of thick greenish yellow pus, having a somewhat fecal odor were withdrawn. The mass was then incised and drained through two parallel incisions. About 10 c.c. of pus were evacuated. An iodoform drain was then inserted between the two incisions. The progress from then on followed an uneventful course to complete recovery, the drainage ceasing at the end of one week and both incisions healing over rapidly, when the drain was removed.

The pus had been sent to the pathological laboratory for routine examination and the report given by Dr. J. MacWhorter was as follows: Direct smear of pus showed many pus cells, gram negative diplococci intracellular and extracellular. Culture showed no growth.

Since we believed that there was a possible error in the specimen reported, an attempt was made to obtain another specimen of pus from the now healed over wound. Fortunately about 2 c.c. of pus were obtained when a hemostat was inserted into one of the scars. The pus was similar in character to the original.

The report on this pus read: Direct smear shows many pus cells, few gram negative diplococci intracellular and extracellular. Culture showed no growth. The diplococci appeared to be gonococci in morphology and reaction to gram stain and in their repeated refusal to grow on agar-agar or in broth.

Subsequent x-ray examinations taken on February 26, 1930 and March 17, 1930 respectively showed:

Fig. 2. Anteroposterior and lateral views of the left leg show the extreme periosteitis noted in the previous film and also an area of erosion of the upper end of the tibial diaphysis. This latter point was probably the original focus of the osteomyelitis, the diagnosis of which was established by the incision and drainage.

Fig. 3. Views of the left upper tibia show much more clear bone detail with less haziness and with smoother bony outlines. The appearance suggests the healing of the inflammatory process. The upper tibial epiphysis has the annular appearance frequently noted in old scurvy and hard to explain at the age of this child.



F1G. 3.

Because we were curious to ascertain the origin of the infecting organism, smears were made of the infant's prepuce and urethra, also vaginal and cervical smears of his mother, and vaginal smears of his two sisters. All of these were reported negative for the gonococcus.

A search of the literature for a report of a similar case of osteomyelitis resulted in failure. H. E. Bardenwerper¹ reports a case of gonorrheal osteomyelitis in an adult, which is apparently secondary to a gonorrheal arthritis.

Speculation as to the mode of infection and portal of entry in the case of the infant leaves one baffled. Obviously there must have been a blood stream invasion which localized in the tibia. The most likely portal of entry must have been through the umbilical cord. However, there was no history of any abnormality in its course in sloughing off. The appearance of the umbilicus at the time of examination was normal. It is possible that the midwife who delivered the child may have been the source of infection. A vaginal smear on her could not be obtained.

¹ J. A. M. A., 94: 1230, 1930.

DISPLACEMENT OF FEMALE GENITAL ORGANS AND THEIR REPAIR*

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ISPLACEMENT of the female genital organs is not always a local condition but frequently is the end-result of a generalized inferiority of tissue resistance. For many women the trauma of the first and subsequent births leads to serious ill effects, and it is especially disastrous if it is connected with a more or less severe tearing of the supporting, muscular and fascial elements.

Etiologic Factors: Enteroptosis, infantilismus, hypoplasia of the muscular elements, and asthenia as interpreted by Stiller, are all etiologic factors contributing to a constitutional deficiency. In a large series of cases, Sellheim found hypoplastic vestiges of the vagina in one-ninth of all the women examined. Congenital retrodisplacement depends upon general visceroptosis, which, in connection with later parturition involving perhaps a perineal laceration, renders the uterus susceptible to prolapse. Descensus, or prolapse of the uterus is invariably preceded by retroversion, but every retroverted uterus does not necessarily fall. Pregnancies and postpartum conditions are factors predisposing to the relaxation of tissues, particularly of the upper segment of the cervix. Naturally, muscular insufficiency will be more pronounced when the puerperal retroverted uterus, with its broad surface, is exposed to abdominal pressure because the pelvic floor has been relaxed. On the other hand. to quote Sturmdorf, "A uterus congenitally retroposed before impregnation will resume its retroposition after delivery, whether the pelvic floor is lacerated or not."

Types of Displacement: In a consideration of the constitutional origin of displacement, four groups may be differentiated, viz., (1) virgines and nulliparae with developmental disturbances, spina bifida, varicosity and obesity of the hypophyseal type; (2) parae with occasional developmental inferiority, spina bifida occulta; (3)

parae in whom symptoms of prolapse develop long after parturition as in preclimax and climax, with lessened tissue resistance of endocrine origin; and (4)

post-climacteric prolapse.

Anatomical Basis: Repair with expectancy of a permanent functional result can be accomplished only through a thorough understanding of the anatomical principles underlying the condition. Intraabdominal pressure must be borne by the muscles and ligaments which constitute a physiologic and dynamic system. In the symptomatology of prolapse the main structures involved are the bladder, the uterus and its appendages, and the pelvic floor. The bladder is suspended from the anterior abdominal wall by the medial and lateral false ligaments, which are in fact only duplications of peritoneum replacing embryonic structures. Support is provided by the uteropelvic fascial plane connecting the lower surface of the pubic bones with the supracervical portion of the uterus. Muscle elements and fascial fibers diverge to both sides of the uterus, thus strengthening the lower portion of the joined broad ligaments. This part, because of its importance in supporting the uterus, is also called the cardinal ligament or, after its discoverer, Mackenrodt's ligament. The other chief means of supporting the uterine body besides the vaginal attachments are the sacrouterine ligaments, which are flat fibromuscular bands extending bilaterally from the upper part of the cervix to the sides of the sacrum at the level of the lower border of the sacroiliac articulation. At the one end these muscular elements are connected with the muscles of the uterus, and at the other end, with those of the rectum (Jackson). The anterior part of the uterine body is attached through the vesicouterine folds, or the peritoneal reflection with the anterior abdominal wall. Corresponding with these folds are the

* Submitted for publication December 27, 1930.

rectovaginal folds on the posterior surface, which are reflected from the rectum to the posterior fornix vaginae. Thus the rectovesical fascia and the levator muscles form a twofold sling. This deflects the uterus in such a manner that the body is forced forward and the cervix is pulled backward.

During labor the cervical attachment of the anterior vaginal wall suffers most often. due to tears and overstretching, thus forming in front of the cervix a portion with considerable less resistance, through which the bladder eventually sinks downward (Kelly). On the other hand, the continuous pressure on the descended bladder stretches the anterior vaginal wall and cervix with consequent descensus of the uterus, and associated retrodisplacement. The anterior part of the rectum takes part in the downward movement and a rectocele is produced. The introitus vaginae gapes, and the non-supported vaginal walls exert an undue pull on the cervix resulting in a supravaginal elongation of the cervix.

Operative Procedures: Numerous operations have been devised to relieve these conditions of the female genital organs. To be useful they must promise permanency and not exclude later parturition. Those are commendable which tend to improve the uteropubic fascial support by means of raising its cervical attachment above the original pivotal point, thereby shortening the base of the broad ligaments. This procedure lifts up the body of the uterus and forces the cervix backward. This correction alone, however, leaves a possibility of recurrence following the trauma of subsequent deliveries. The uterine body should be kept in an anteroflexed position but without undue fixation. With this aim in view, Polano devised an operation by which uterine attachment was accomplished by strips from the rectus fascia sutured to the anterior surface of the uterine body. It was found that at later pregnancies the sutured part became elongated and cord-like. Schubert improved on his method by attaching fascial strips to the spoterior surface of the uterine body. He used free transplants of the ileotibial tract and subsequently prepared strips of the pericard of beef. The foreign strips did not take well in the process of healing.

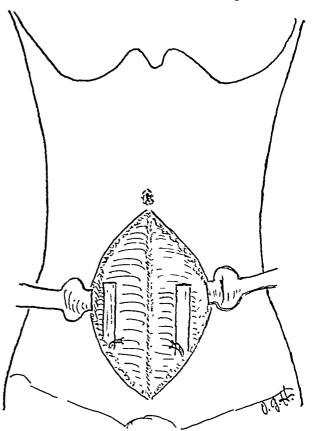


Fig. 1. Fascial strips outlined. Lower end remains attached and is reinforced with catgut stitch to muscle.

The following procedure proved to be satisfactory in 14 cases of the author's. I venture to suggest its use inasmuch as at reexamination one and two years later even after subsequent pregnancy, the uterus remained in the reconstructed position.

The operation can be divided into four steps viz.,

- 1. Median low laparotomy.
- 2. Dissection of a strip of about 12 cm. long from the rectus fascia on both sides.
- 3. Placement of the uterovesical pivotal sutures.
- 4. Attachment of the fascial strips to the posterior surface of the uterus.

Technique: 1. An incision is made in the midline between the umbilicus and the symphysis. The skin being well retracted, on both sides the rectus fascia is stripped clean to expose the outer contour of the muscle. The rectus sheet, which is a part

of the fascia of the external oblique muscle, is strongest near the outer edge of the straight muscle and therefore this portion

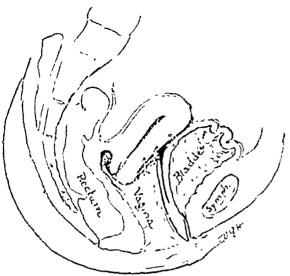


Fig. 2. Catgut stitches fix relaxed vaginal wall and bladder to uterine body. (After Kelly.)

should be utilized. A quadrangular flap 12 by 2 cm. is dissected. The lower pole of this strip is at the level of the internal os of the inguinal canal and remains attached. The flap is turned over to one side and is covered with a moist pad. The rectus sheet is fastened with running catgut suture (Fig. 1).

- 2. At this point, after opening the abdomen I partly follow Kelly's technique, namely, elevating the bladder by means of two Allis' clamps, thereby putting the anterior vaginal wall on the stretch. The uterovesical reflection of the peritoneum is incised and the bladder pushed back by gauze dissection. The uterus is clamped above the internal os, and two sutures are placed in the muscle and the anterior vaginal wall, which lifts up the relaxed wall and supports the bladder. For this important suture, forty day chromic catgut No. 2 is used. Another suture attaches the bladder fundus at a higher point on the uterus (Fig. 2).
- 3. Before closure, the free end of the fascial strip is caught with a slender uterine packing forceps and carried through the abdominal wall at the internal os of the inguinal canal. The forceps is pushed forward between the layers of the broad

ligament emerging at the posterior surface of the uterus, below and near the tubouterine junction. The end of the strip is

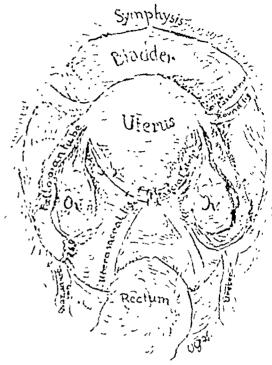


Fig. 3. As viewed from above. Fascial strips sewn on posterior surface of uterus with a few catgut stitches.

grasped, and the forceps is withdrawn. The same procedure is carried out on the other side. Both fascial ends are now pulled down to the uterosacral ligaments, and there joined to the uterus with a few chromic gut sutures. The free section of fascia is covered with peritoneum to avoid adhesions (Fig. 3).

This procedure lifts up the uterus, at the same time leaving it flexible, and free to grow at later pregnancy.

SUMMARY

The operative technique here described is suggested for prolapse and retroversion of the uterus, with due consideration for the dynamic and physiologic system by which the uterus is fixed in its normal position. Recurrences to the former pathological condition are not apt to take place because there are no impediments to pregnancy. Another advantage is that the method can be used in any stage of prolapse.

[For Remainder of References see p. 262.]

STRICTURE OF THE FEMALE URETHRA*

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Y interest in this subject was aroused ten years ago by a case I saw diagnosed as a pus tube instead of as a distended bladder, due to a stricture of the urethra, and this diagnosis was made in spite of the fact that in each of the departments of the dispensary the patient attended for months, her chief complaint was difficulty in voiding.

The purpose of this paper is:

- 1. To present the 4 cases I have examined, treated and followed since they came under observation, and to review the 169 articles analyzed, together with the discussion of this subject in the various Systems of Surgery, Gynecology, Obstetrics and Urology.
- 2. To analyze the etiological factors of stricture, and to show that gonorrhea is the most common cause, and that carcinoma is a more frequent cause than is generally considered.
- 3. To urge that no case should be reported as a congenital stricture, unless it fulfills Young's requirements.
- 4. To stress the fact that no examination of the female pelvis is complete without a urethral examination.
- 5. To urge a complete study of these cases by cystoscopy, functional tests, and x-ray in order to determine the pathological changes, if any, that follow.

Barthelmey, in 1550, reported the first case of stricture of the female urethra, a congenital type, in which the urethra was completely closed, and the urine passed through the umbilicus. Lisfrance in 1824 and Civiale in 1850, brought this subject more forcibly to the attention of the medical profession. The most careful work has been contributed by Herman, who reported 23 cases in 1886; Hamon in 1901; Vilfroy in 1911; Wynne, 40 cases in 1922;

Pugh, 68 cases in 1926; and Gorowitz, 17 cases just recently.

For the completeness of this paper, I would like to present briefly the anatomy of the female urethra. It is 3.5 cm. long, and 7.5 mm. in diameter, and pursues a course downward and forward under the symphysis pubis. The mucous membrane is stratified epithelium, except near the bladder where it becomes a transitional type. Many small mucous glands lined with columnar epithelium dot the anterior portion, and Skene's glands empty into it at or near its external orifice. The muscular layer consists of inner circular and outer longitudinal fibers. The external layer is fibrous tissue.

Imbert and Soubeyran say that the female urethra represents embryologically that part of the female urethra which is never involved by gonorrhea; therefore, the gonococcus can never be a cause of stricture here. Most authors, however, state it is the most common cause, especially Kleinwachter, Herman, Wynne, Pugh, Stevens and Bagot who claims that one-third of the cases are so caused, but that the stricture does not appear for from five to eight years after the acute onset. Pugh claims that 90 per cent of his cases were due to gonorrhea.

From the case reports in the literature, this is well borne out as follows: gonorrhea, 121 times; carcinoma, 50; obstetrical, trauma, 38; traumatic, 19; syphilis, 17; non-specific infection, 15; congenital, 13; senile thickening, 12; polyps, 9; spasmodic type, 5; calculus and infection, 4; gonorrhea and lues, 4; ulcers, 4; chancroid, 4; benign tumors, 3; electrolysis, 2; postoperative, 2; lupus, 2; kraurosis vulvae, 2; typhoid, 2; and one each of the following conditions, typhus fever, fissure, masturbation, tuberculosis, burn, scarlet fever,

diphtheria, keloid, sarcoma and melanosarcoma. To these I would add 4 cases, whose etiology could not be proved bacteriologically, but clinically seemed certain; I from gonorrhea, I from chancroid associated with gonorrhea, I from a luetic ulcer and gonorrhea, and I from nonspecific infection associated with calculi.

Contrary to Kleinwachter's opinion that tumors rarely cause stricture, and if they do only in the beginning, about 50 per cent of the reported cases produced stricture, and most of these in the last six months of the disease. It is interesting to note that only 1 case was reported as due to tuberculosis, which is about as infrequent as for the male, according to Young.

Some question is raised by the author relative to the classification of the following 2 cases reported as congenital strictures, as they do not fulfil Young's requirements: namely that the history of difficulty in voiding should begin from birth, and that there ought to be hypertrophy and dilatation of the bladder, ureters, and kidney pelves. One patient having pyelonephritis yet showing a negative specific history, stated that her trouble began in adult life. The other, a woman of thirty, who had a pearly-white diaphragm in the urethra with a central perforation, gave a history of difficulty of only two years' duration, and a combined infection of gonorrhea and syphilis. Some authors claim that a pearly-white membrane with a central perforation always indicates a congenital stricture. This is not true, because last year I saw such a membrane in a male urethra where a stricture, due to gonorrhea, had been dilated three years before.

I cannot agree with Boyd when he interprets all children's urethras which will not admit a French No. 20, as congenital strictures, because in the treatment of genital infection in children many urethras will not admit over a No. 16 catheter.

I do not believe that these so-called soft strictures, really edema of the mucosa, should be classified as true strictures, because if the edema subsides, the trouble disappears without resort to dilation. Every one has seen cases where retention has followed an alcoholic spree, or a severe chilling from a long ride in the winter, or after sitting through a football game. Just recently I saw a man thirty-eight years old who having drunk profusely the night before, had retention, due to congestion.

Interesting, too, but differing considerably from the male is the location reported most frequently involved by the stricture: anterior third, 86; middle third, 18; posterior third, 12; entire urethra, 12. There were a few cases of multiple stricture reported. These were not included in the figures, nor were those due to carcinoma, which usually involved the whole canal.

One cannot draw any accurate conclusions as to the period of life when these strictures, due to inflammatory processes, begin, because the age was stated only in 137 of the 431 cases recorded. However, it would appear that most occur during middle life. On the contrary, a rather accurate period can be established for those caused by malignancy, since the age was reported in 42 of the 48 cases, as is easily seen in the following chart:

	_	
Age	Inflammatory	Malignancy
under 1 vear	3	0
1-10	4	0
10-20	6	0
20-30	31	2
30-40	36	7
40-50	29	18 18
50-60 60-70	17	18
60-70	11	10
70-S0	О,	ı
	i	

The size of these strictures can be stated only with relative accuracy because of the many types of instruments used; but reducing those given to a single scale, we have approximately the following from the literature which shows that the filiform or near filiform is the most common.

21-26 French bougie .	3
16-20	3
11-15	. 8
6-10	. 14
Filiform-5 French	42
Filiform	70

Pugh states that if a French No. 16 or smaller cannot pass, it constitutes stricture, especially if symptoms of difficulty in voiding and frequency are present. Lerouelle says some strictures will allow only a French No. 20 to pass. Bugbee and Cheetham classify a condition allowing French 22 or smaller, a stricture. Stevens calls everything that permits a French 26 to pass, one, if any bladder symptoms are present and reports 173 such cases out of 234 patients examined for bladder trouble, although he states that only 56 had real symptoms. On the other hand Herman measured 55 normal cases where only a French No. 17 could be passed. Bugbee reports 692 cases in 1000 of patients complaining of frequency, Cheetham 16 in 100, Winkel 3 in 3000 gynecology admissions, Fischer 4 in 4000, Hamonic 12 in 5000.

These strictures varying from a thin membrane to a bridge of tissue, may cause very serious complications. It is interesting to note that in the available literature, no case of female urethral fistula is recorded, except one reported by Winchel due to an ulcerating carcinomatous stricture. Young states that damage to the bladder, ureters or kidneys is rare in strictures of the urethra because if the bladder empties at all, it usually does so completely. There was no damage to the ureters or kidneys in one of my cases even when for several years, there was constant retention in the bladder of over 300 c.c. On the other hand Kreutzmann⁹⁴ states that a considerable number of cases where urethral obstruction was present for some time, showed a dilation of the ureters and kidney pelves. This he believes is due to hypertrophy of the bladder muscles causing constricting bands about the lower ureters. Autopsy reports of various cases have shown enlarged, thickened, and trabeculated bladders; dilation and hypertrophy of ureters and kidney pelves; enlarged and thick-walled kidneys. According to Heinricksdorff a purulent cysto-ureteropyelonephritis was present in 2 cases of stricture following a cicitricial

contraction of vesicovaginal fistulas caused by childbirth trauma. Tuckermann in 1899 reported a congenital stricture in a girl five years of age whose autopsy report showed the bladder distended to the umbilicus, the walls very thick, and a very small cavity in the fundus of the bladder full of pus from which a staphylococcus was cultured, both ureters irregularly dilated, and both renal pelves markedly enlarged. Stevens claims that 54.5 per cent of ureteral strictures have urethral strictures and in 46.1 per cent of urethral strictures he found ureteral strictures. Hunner according to Stevens found that 85 per cent of his ureteral stricture cases had urethral strictures. On the whole, only a comparatively few complications were reported because relatively few autopsies were performed and only a record of 6 cystoscopies which were performed by Cheetham. No renal functional tests or pyelograms reported.

The symptoms in the female are the same as in the male: frequency, pain, burning, passing of small amounts of urine, difficulty in starting the stream, straining during voiding, increase in emptying time of the bladder, constant desire, urgency, dribbling and diminution in the size of the stream down to a fine spray or complete retention. Uremic and toxic symptoms such as headaches, drowsiness, depression, irritability and nausea occur. Fatigue, lack of ambition, abdominal discomfort and weakness are complained of. Stanton and Cheetham report renal colic symptoms due to urethral strictures. The duration of symptoms varied from a few weeks to twenty-six years. In cases due to non-malignant causes, the symptoms most often reported in order of frequency are: difficulty in voiding, frequency, pain and dribbling; whereas in those due to malignancy the symptoms are bleeding, frequency, difficulty in voiding, retention, pain and burning.

Treatment varied according to the cause from the simplest procedure of dilation to the radical operation. In that due to malignancy excision of the urethra often with a portion of the bladder was performed in 30 of the 48 cases whereas radium and x-ray were used only in 4. In non-malignant strictures gradual dilation was performed seventy-eight times, internal urethrotomy in 31, suprapubic cystotomy and retrograde dilation in 3 cases and rapid dilation, trochar, galvanism and electrolysis in a few.

I want to report 4 cases of stricture of the female urethra I have seen since 1920 in a dispensary service of two hospitals, one for two years, the other for eight years.

CASE I. N. M., colored, aged forty-one, was seen March, 1922, complaining of pain in the lower abdomen, of burning, smarting and frequency of urination, of painful and difficult urination, of slowness in starting the stream, of a very small stream, of inability to hold her urine, and of a feeling that she never emptied her bladder. She further complained of nausea, headache, drowsiness, loss of ambition, inability to work, of convulsive seizures, all of which had been present for one and one-half years. She gave a history of antileutic and antigonorrheal treatment since the appearance of a sore about the urethra and a discharge in 1917. Wassermann reaction 4 plus. She had one child seventeen years old.

Examination revealed a soft, tender mass in the lower abdomen reaching half-way up to the umbilicus. The cervix presenting a little discharge was in mid-position. The mass felt covered the uterus both anteriorly and laterally. The urethral orifice was a displaced depression, the result of scarring about the site of an old ulceration. It would not admit a No. 10 F. catheter. Therefore, I had her void while on the table to see if the urine did pass through the depressed place, and she passed a fine spray-like stream. The depression was filled with filiforms and one jumped through a small opening under the bridge of tissue that overlapped the orifice. A No. 12 metal follower was attached and forced through removing 350 c.c. of urine. The supposed pus tube disappeared. The urethra was dilated periodically until April 3, 1922, when a cystoscopic examination showed congestion and trabeculations about the trigone and posterior wall of the bladder. Catheters were passed uninterruptedly to the kidney pelves. Each held 10 c.c. Indigo carmine functional test was performed, 5 c.c. intravenously. The appearance time was four minutes. After collection for ten minutes the right kidney secretion was normal and 25 per cent more than the left kidney. Phthalein test was 55 per cent in two hours.

CASE II. C. S., colored, twenty-eight years old, presented herself on Jan. 20, 1927, complaining of pain in the lower right abdomen, of frequency of urination, occasionally every five minutes, of difficult voiding over a period of six years, of nycturia four to five times. She had been married for twelve years and had one child that died at six months of age. She had had leucorrhea for two years and bilateral Bartholin gland abscesses, urethral polyps and a cicatricial scarring from a chancroid, which produced a stricture of the urethra. Wassermann test was negative and no gonococci were found. Both glands were excised and several polyps 15 in. long were removed from the urethral orifice. A stricture filiform in size which was situated 1/3 in. within the urethra, was dilated.

Cystoscopic examination was done and pyelograms made on February 7. The bladder mucosa was somewhat congested but had no trabeculations. Number 6 catheters were passed uninterruptedly to the kidney pelves. Indigo carmine test was normal. Both kidney specimens contained a trace of albumin, wac, are and B. coli. Pyelograms showed the right kidney enlarged but no change in either pelvis except that the major calyces showed a little unusual branching. There was no evidence of calculi.

CASE III. F. B. colored, aged forty-seven, came in complaining of nycturia, some difficulty in voiding, frequency and a vaginal discharge. She had had an operation for fibroid uterus and pus tubes fifteen years ago. Prior to this she had had two spontaneous miscarriages. The cervical smear showed no gonococci. Wassermann test was positive. The urethra would only admit a No. 10 F. dilator but was easily dilated as the stricture was formed by an induration of the wall in the anterior third of the urethra. B. coli was cultured from the bladder urine. She refused cystoscopy, so dilation of the stricture and antiluetic treatment only were done. This stricture, I believe, was due to gonorrhea as there was no evidence of any ulceration or scars.

Case IV. This woman, M. McA., seventy-

three years old, colored, was seen in Oct., 1928, complaining of blood in the urine for six months, of bladder trouble for thirty years, of frequency, often every fifteen minutes, of passing small amounts of urine, of dysuria, of difficulty in voiding, of a small stream, of urgency, of nycturia four to five times, of passing sand and pebbles for the last three days. She had cramping pains in the kidney regions, radiation to the lower back, groin, and to the anterior surface of the thighs. There was no venereal history, but she and many of her family gave a history of tuberculosis.

Examination revealed tenderness over both kidneys and bladder. The urethral orifice was small and the canal rope-like to palpation throughout its entire length. The ureters were not felt bimanually. There was no vaginal discharge. The uterus and adnexa were small and located normally.

The stricture was dilated from a No. 12 F. to 26 and cystoscopic examination showed much congestion of the bladder mucosa, and many large trabeculations behind the trigone. A small white stone was removed. The ureteral orifices were very prominent and congested. A No. 5 catheter could not be passed over 2 cm. into the right ureter. A filiform was passed and then a No. 4 catheter. Only a filiform could be passed into the left ureter. Catheters met an obstruction 3 cm. within. Specimens collected were blood-tinged. Indigo carmine, 5 c.c. injected intravenously, appeared from the right kidney in five minutes and from the left kidney in eight minutes. Collection for

a ten-minute period was about 60 per cent from the right and 40 per cent from the left kidney. X-rays showed the right kidney pelvis normal and the left slightly enlarged. No calculi were present. Cultures showed a staphylococcus in the bladder specimen but no growth from either kidney. Further treatment consisted of urethral dilation and bladder irrigations. The ureters were dilated to a No. 8 F. and the urethra to a No. 28 F.

In conclusion, it seemed to me several important facts could be deduced from all these case reports.

- 1. That gonorrhea is the most frequent cause of stricture of the female urethra.
- 2. That carcinoma is a far greater cause of stricture than is generally supposed.
- 3. That all strictures reported as congenital should fulfill Young's rule.
- 4. That dilation and hypertrophy of the ureters and kidney pelves are not frequently associated with stricture of the urethra with the exception of the congenital type.
- 5. That all cases should be completely studied by cystoscopic functional tests, and x-rays taken to determine all the accompanying pathological changes.
- 6. That the so-called soft stricture should not be classified as a stricture.
- 7. That the female urethra should not be overlooked in examination.

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STRICTURES OF THE URETER*

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In the last few years there has been much work directed toward clarifying the understanding of ureteral stricture of non-tuberculous origin, its cause, diagnosis, symptoms and pathology. Yet the work is not completed. There is still a great deal of discussion relative to the manner of diagnosis, and also to the various causes and the existing pathology.

It might be well to review for a few minutes the opinion on pathology of ureteral stricture. Hunner first described ureteral strictures as narrow and wide. The wide type of stricture has received most attention because it has seemed to be the most difficult to agree upon. Hunner claims that a wide stricture is due to a cicatricial band around the ureter causing a thickening and at times a swelling that is sufficient to partially occlude the ureter; that the wide stricture does not necessarily cause evidence of back pressure, that it may cause no obstruction to a catheter. The wide stricture is considered to be of the acquired type. On the opposite side, Braasch and his following are very dubious about the existence of anything like a wide stricture because there is no way of accurately determining it. There is also the congenital stricture which is now believed to be not infrequent. Campbell of New York reports ureteral stricture in 1 per cent of 13,000 necropsies done at Bellevue Hospital. Campbell also reports in a study of 2420 pediatric autopsies an incidence of ureteral blockage of 2 per cent. Over 50 per cent of these cases were due to intraureteral narrowing and most of them were congenital.

Carson of Milwaukee reports that in 300 consecutive autopsies done at the University of Maryland he found 8 cases of pronounced inflammatory ureteral stricture and 3 cases of congenital stricture. On the

other hand, Dr. Aschner claims that ureteral stricture is extremely rare and that the cases seen at Beer's Clinic in New York could all be counted on the fingers of one hand. I am convinced that this opinion does not reveal the true situation because in my own experience I have demonstrated unquestionably a large percentage of ureteral strictures and I am only including those cases that have shown marked undeniable evidence in the x-ray film of the lesion. We must recognize the fact that there are different pathological stages in every case. Some cases will show evidence of ulceration with little scar tissue; some will show even earlier stages of inflammation where the process has been slow and in these cases usually the back pressure is not evident all the way to the kidney if the lesion is low in the ureter; then some cases will show a full and complete scarring when the blockage is due practically entirely to the contraction of the scar and in only a small measure to the active swelling resultant from the inflammation. It is not necessary as Carson claims that every case show kidney stasis. One might be dealing with an early case that has not gone that far.

Pathological end-results of ureteral stricture, of course, are ureteral and kidney stasis and infections above the stricture often leading to complete destruction of

kidney.

Hunner reports many conditions due to ureteral stricture such as (1) essential hematuria (2) hydronephrosis (3) pyonephrosis (4) pyelitis (5) urinary calculi (6) some medical nephritides (7) much of the pathology in congenitally malformed kidneys and many so-called bladder neuroses.

Etiology: What causes all these ureteral strictures? I believe that the common

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pyogenic organism is in nearly all cases the exciting cause. I have not been able to demonstrate one case of gonococcus infection in this study. These cases all have negative Wassermann reactions. The colon bacillus, the staphylococcus and streptococcus have been the offenders either alone or together. One case of pure culture of micrococcus catarrhalis was found. In Sugimuras' autopsy study of the lower ureter in 25 cases of patients having infection in the bladder who died from other causes, he found marked inflammation which seemed to him to have traveled into the ureter through the lymphatics rather than by the mucosa.

Severe inflammation of tube and ovaries would seem to be an ideal cause for the origin of ureteral stricture, yet Hunner states that in his wide experience he has yet to see a case that he could definitely say was due to this cause. Dr. Scott Pugh of New York reports obstruction of the lower ureter due to seminal vesiculitis but does not show any x-ray evidence of stricture. He claims that the obstruction does not go on to stricture formation but subsides with the vesiculitis.

Not considering trauma I believe that most ureteral stricture can be traced to hematogenous infection from distant parts of the body; appendix, tonsils, teeth, gall bladder and so on. One patient here shown suffered from recurrent attacks of appendicitis over a period of several years. During one acute attack the badly infected appendix was removed. Ten days postoperative the patient suddenly developed a severe pain in the left kidney region, colicky in nature and associated with bloody urine. Kidney stone was suspected so we cystoscoped him and found a strictured left ureter with acutely distended kidney pelvis from which 18 c.c. of bloody pussy urine gushed through the catheter. A symptomless stricture was also found on the other side. All the patient's symptoms disappeared after the first dilation and we have now dilated him the third time to the size of a No. 9 F. catheter.

SYMPTOMS

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Probably the most important and the most leading of all symptoms is that of pain, in many cases of dull aching, vaguely located pain, sometimes in the lower right or left quadrant of abdomen, sometimes in the region of the umbilicus, sometimes higher up in the back. The pain is not usually of a definite and intense character but of such a nature that almost any diagnosis might be made. If on the right side it is usually called appendicitis and operation is advised.

Backache is the next most frequent symptom, commonly located across the small of the back, sometimes high in the kidney areas and less often over the sacrum. The pain is usually dull in character and non-radiating.

Some patients complain of bladder frequency which is intractable until the strictured ureter has been dilated. There may be no demonstrable cystitis and there may be no pus in the urine. The fact that no bladder symptoms occur does not rule out strictured ureter, because 30 per cent of cases show no bladder difficulty.

In women symptoms of ureteral stricture are many times confused with menstrual pain. At first, pain may be associated with menstruation probably because the engorgement occurring during this period causes greater swelling in the mucosa of the pelvic ureter producing more blocking and consequently more pain. After the ureteral stricture has been present for some time, however, these pains continue through the period between the menses.

We suspect ureteral stricture in women who have been having normal periods and suddenly develop menstrual pain and in women who have no other pelvic pathology demonstrable or who have not received relief from dysmenorrhea by childbirth or cervical dilation.

DIAGNOSIS

Most of the discussion and debate going on in this subject of ureteral stricture is concerned with the diagnosis. When is a ureteral stricture present? Guy Hunner says he can invariably diagnose stricture of the ureter by the hang of a ureteral bougie. To substantiate his claim he has made some interesting experiments. For instance he has had a patient in whom he diagnosed stricture at a certain location in the ureter by means of a hang when removing a bougie and has operated upon the patient. With the abdomen open, the ureter visualized, the patient having been under a deep anesthesia for some time. he has repeated the withdrawal of the bougie and has gotten the same hang at the same location in the ureter. This seems to be definite enough evidence in the hands of Hunner, but who can duplicate it? I confess I have not been able to be certain of a hang even in some cases that were definitely shown to be stricture by other methods.

Depending on the obstruction to a ureteral catheter to diagnose stricture is entirely unreliable because many times the catheter will catch on a fold of mucous membrane or some angulation of the ureter without stricture being present. That will be most misleading. Use of the catheter with the injection of ureter with some opaque solution for a ureterogram is the most reliable method of diagnosis.

There is a new method of visualizing the ureter by means of the injection of an intravenous solution of sodium iodide and urea. This solution has proved extremely satisfactory so far, particularly where there has been any degree of stasis in the urinary flow. There is a great argument in its favor because it visualizes the urinary tract in an undisturbed condition. From the little experience I have had in the use of this preparation, and review of the recent literature, I believe that the problem of discerning any degree, however slight, of a ureteral blockage has been solved.

There have been many experiments made in trying to find a solution that could be used intravenously or by mouth, to visualize the urinary tract. In 1924 as far as I can ascertain, the first experiments were made at the Mayo Clinic. There, a preparation of sodium iodide was used both orally and intravenously but with very unsatisfactory results. In 1924, Von Lichtenberg, also tried by the use of intravenous preparation to get a shadow in the ureter or kidney. He also failed. Several years later Roseno and Jepken of Berlin began attempts with many preparations injected intravenously in order to get a kidney shadow. They finally came back to the use of iodine salts. There experiments with dogs began by the use of a to per cent solution of sodium iodide injected into the femoral vein. They got no shadows except in the bladder where the urine was retained over a considerable period of time. These shadows were very poor so they paralyzed the bladder muscle by large doses of morphine prior to the injection of the iodide in order that they might get a longer retention in the bladder. By this means they got a very good picture of the bladder outline, but absolutely none of ureter and kidney. The injection of the iodide almost invariably killed the dog. They resumed their experiments with the injection of iodide, after ligating one ureter. This resulted in a very good outline of the kidney pelvis and ureter on the ligated side. The problem now presented itself of getting a preparation that would throw a shadow in the ureter and kidney, without the necessity of ligating the ureter and without killing the dog.

I believe Roseno was the first man to successfully use a combination of urea and sodium iodide. He thought of urea because of its normal existence in the blood and urine. He experimented with many combinations of the two drugs, until he had now successfully demonstrated that large amounts of sodium iodide can be given intravenously in combination with urea without any untoward effects.

In the early part of 1929, he employed a solution of about 38 gm. of sodium iodide in 300 c.c. of water with a slightly greater

amount of urea. This work was done on human beings after a larger percentage had successfully been administered to dogs. It seems that the presence of urea with the sodium iodide makes the sodium iodide practically non-toxic. The urea being rapidly eliminated by the kidney carries the sodium iodide very rapidly through the kidney. The iodide itself acts as a specific diuretic. The presence of a large amount of sodium iodide and urea in the blood causes a flow of lymph into the blood stream. This also acts to reduce the toxicity of the iodide. The entire injection of 300 c.c. is given over a period of fifteen minutes. It begins to appear in the urinary tract in the kidney that is functioning nearly normally almost immediately. Some cases show a very rapid elimination of the iodide, so that an x-ray picture is always taken immediately to ascertain the outline of the kidney pelvis which is sometimes manifested so early. Another picture is taken on the third hour after the injection and also on the fifth hour. In order that the iodide may be retained and its expulsion from the body retarded after it has been secreted by the kidney, the injection is always given with the urinary bladder as greatly distended as possible. The iodide is for the most part eliminated within five hours, although traces are sometimes seen in the urine from twenty-four to forty-eight hours following the injection.

The drug injected seems to be practically non-toxic. Roseno has had no reactions other than some dizziness and headaches immediately following the injection. These symptoms have never been severe and have passed away within a few hours after injection.

Before any injection is made, it is a very wise idea to paint a portion of the skin of the patient with tincture of iodine in order to ascertain whether there is any possible iodine idiosyncrasy. If there is no erythema of the skin twenty-four hours after being painted with tincture of iodine, it is safe to inject the iodide. The only other contraindications for this procedure so far as

we know now, are a thyrotoxicosis and pulmonary tuberculosis.

Much work has yet to be done, but I



Fig. 1.

believe that with a small amount of modification this procedure will be standardized in a short time and will eliminate all the controversy going on now over the existence of obstructions in the ureter which are difficult to diagnose by our usual pyleographic methods. I have injected this solution in 1 case. I did not have the courage to use the full dose sent to me of approximately 38 gm. of iodide. I did use half or approximately 250 grains in 200 c.c. of water. I procured a shadow in the renal pelvis which was entirely satisfactory, yet not as pronounced, of course, as it would have been had I injected the whole dose (see Figs. 1 and 2).

Many of the so-called harmless kinks of the ureter if examined closely will give evidence of stricture at the bends or in the immediate region above or below. Kinks and turns are not harmless by any means.

Irregularities of distention above a suspected stricture area sometimes seen are, I believe, explained by an incomplete filling of the ureter and kidney pelvis. There has been some question as to whether a stricture is present because in some x-ray

pictures there seems to be a dilatation below the stricture area. This apparent dilatation I believe is usually due to

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Fig. 2

incomplete filling of the ureter. The fluid is injected usually below the site of stricture so that the stricture blocks the upward progress of the fluid; if the injection is not continued long enough or if the patient is not in the extreme Trendelenburg position there will be an apparent dilatation of the ureter below the stricture, particularly so if the ureter is of a large caliber normally. I have been able to show the apparent dilatation of the ureter below the stricture by repeating the urogram and continuing more pressure so that the portion of the ureter above the stricture is completely filled. It may be well to review the innervation of the ureter and kidney pelvis at this point, Possibly some light can be thrown on the explanation of some of these irregular dilatations.

The nerve supply to the ureter comes from the sympathetic nervous system being derived from the vesical, spermatic, inferior mesenteric, and renal plexuses. They form a network around the ureter, the end branches being mostly given to the muscular coats although many branches can be followed to the epithelium. According to some authorities some medullated fibers have been demonstrated.

The nerve supply can easily be dis-

turbed by scar in the epithelium or muscle or by simple irritation to these tissues. Dilation therefore may occur anywhere along the ureter as a result of lack of tone and consequently atrophy of muscle tissue. But usually when urograms are repeated in these cases of atonic dilation the dilatation varies in extent and many times in location; at least enough change takes place so that there is a slight reason for mistake. Just as atony of the ureter occurs so also can spasm of the ureter occur. Usually when spasm occurs there is either a recent infection in the ureter or a highly nervous type of patient; or there has been very little blockage in the ureter. Ordinarily there is no spasm following urogram if a stricture has been present and it is not very tight. Of course when a stricture is dilated and there is considerable trauma from catheterization causing a resultant swelling at the stricture site, then spasm and pain may be exceedingly acute.

If a spasm is suspected in the ureterogram usually all one has to do is to pass a catheter into the kidney pelvis and irrigate with Ag No. 3 once or so and then repeat the ureterogram and the spasm very frequently will not show again. Sometimes when due to a stone in the pelvis a spasm at the ureteropelvic junction is rather constant in the ureterogram. However, when this is the case the patient usually has to have a pyelotomy done and the ureteropelvic area can easily be investigated. Braasch and several others have been able to demonstrate the spasmodic nature of this condition during operation.

Now the question arises as to treatment. Is the treatment dilation? It is the only treatment we have that is a very good one. That the dilation treatment has failed to give permanent cure in some cases is no reason for condemning it as some prominent urologists have done. A scar in the urethra or anywhere else where it is around the circumference of an organ will contract slowly and sometimes rapidly, after it has been stretched wide open. In the urethra we have so-called "gummy"

stricture that has to be cut before it can be dilated to stay for any length of time. So also we have sometimes a gummy type of stricture in the ureter that will not stay stretched for any length of time. The fact that relief sometimes is not rapid or permanent following dilation of the ureter is no reason to say that it is not to be continued or should be condemned. A large percentage of the cases that we have had have been quickly relieved of symptoms following dilation. There are two that have not been relieved after three dilations to the size of a No. o F. catheter and did not care to continue treatment, but had they gone to a point where the ureteral drainage had been free I am sure their symptoms would also have been relieved.

Hunner's report of his first 100 cases five years after treatment is interesting: 31 answered as entirely cured; 48 as greatly improved; 31 somewhat improved, and 8 unimproved.

Braasch reports that in 100 cases dilated at the Mayo Clinic 5 answered to complete cure; 10 who had other forms of treatment reported partial cure with subsequent recurrences. The remainder he says were either not relieved at all or just temporarily.

Of the 12 cases in this series 20 have been relieved without recurrence in two years; 12 have been relieved for varying length of time but had to be dilated occasionally to keep symptoms of pain from recurring; 2 were not relieved after several treatments. They were dilated up to the size of a No. 9 F. catheter. I am unable to say whether they would have been relieved if they had been willing to continue further treatments of greater dilations; of 8 we have no follow-up knowledge. Whether they were sufficiently relieved that no further treatment was necessary or whether the pain of the dilation was greater than they cared to suffer I do not know. Now the question arises, how long shall we continue to dilate? As long as the pain recurs and dilation relieves the pain. One patient in this series has been dilated three to four times at weekly intervals every

three months for the past three years. She works regularly now and has gained weight; is entirely free from pain following her three to four dilations for periods of three to four months. Her invalidism has been cured.

From my study of these cases my conclusions are (1) that ureteral stricture is a rather common disease; (2) that there is evidence to show that ureteral stricture many times is due to foci of infection in distant parts of the body; (3) many of the vague mysterious pains in the abdomen can be explained by study of the ureteral tracts; (4) that the so-called wide stricture is doubtful; (5) that the bulb method of diagnosis is most difficult, also uncertain; (6) that many of the cases showing dilatation below the stricture are due to faulty filling of the ureter; (7) that dilation of strictured ureter is a very efficacious means of treating the condition, curing approximately 50 per cent and giving great relief for some time at least in a far greater percentage; and (8) repeated dilations are justified over any period of time if the patient is relieved following dilation.

DISCUSSION

Dr. Ferrier: I believe Dr. Mulvehill is a little too enthusiastic in regard to the diagnosis of strictures of the ureter. A stricture has to be consistent and it has to be of uniform length and in some of the pictures which he has shown it did not so easily bear this out.

The other point is this: spasm and kinking very often simulate a stricture so it is necessary frequently in order to be absolutely certain that you have a stricture to take one or two successive plates to prove that it is consistent and uniform in type, size and shape of the stricture.

In regard to the treatment, dilatation, as we all know, is probably the only form of therapy that does any particular good.

Dr. Mulvehill: The cases that I showed were picked out particularly because they had been mulled over so many times.

One girl had been operated on; she had had her gall bladder, tubes, ovaries and appendix removed, and one of our leading internists told her that her trouble was all in her mind, psychasthenia, and advised a long rest so that she would get over her pain. She did not believe that she was a psychasthenic so she kept travelling around until finally she reached us. We cystoscoped her and found what we believed to be indisputable evidence of ureteral stricture and after her ureter was dilated she was able to go back to work and has had no pain at all. The others are all the same.

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I believe that if you get a case of this kind where there is a distinct narrowing of the ureter with a tremendous dilatation or a marked dilatation above that area and the introduction of a bougie through that narrowed area relieves the patient of the distinct symptom, that you have hit something that is pathological. It could not be a spasm that has given the patient a severe degree or a mild degree of pain over a long period of time.

The pain can be most any place, can be referred to the back, or a typical appendiceal pain, can be on one side or the other. That is the misleading factor about it.

Dr. Criley: Does it ever refer to the extremities?

DR. MULVEHILL: The pain is rarely radiating as it is in ordinary kidney stone. These cases that I showed on the screen were cases that had no urinary findings so the examining doctor concluded that the urinary tract was okay. That is one reason that the urinary tract was never inspected.

I believe with Dr. Belt that the introduction of sodium iodide and urea is going to clear up this question entirely. I believe that the solution will show the slightest amount of blocking along the ureteral tract and I think that most of the difficulties are practically solved by this method.



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*Continued from p. 250.

A UNIFIED PLAN FOR KEEPING RECORDS OF CARCINOMA OF THE UTERINE CERVIX*

Frederick E. Neef, M.D., F.A.C.S.

NEW YORK

In the study of cancer generally, the large amount of work that has been done with radiotherapy in cancer of the uterine cervix deserves more than casual attention by the surgeon, even if it were for no other reason than to learn how cancer responds to radiological treatment, or to determine whether some of the principles that have been revealed in the therapy of cervical growths are applicable elsewhere.

The basic requirement in scientific work is an accurate record. In clinical research, the patient who is, as a rule, untrained in observation concerning medical matters, becomes a factor. The shortcomings of the interne in training, on whom the task of obtaining histories usually devolves, must be taken into account. Finally, the findings which one attending surgeon dictates, may not tally in grouping or detail with those of another, because of personal equation or difference in standards according to which an estimate of the condition is formed.

For such reasons as these, records need to be standardized to make them uniformly serviceable for comparative study. This can be done by formulating a syllabus of the guiding lines along which data are to be obtained and recorded.

In a working system of this kind the record sheets should cover, firstly the Admission, secondly the Revision, and then the Final Summary. Each outline can be printed on quarto-size paper to fit the patient's chart and each sheet perforated at one margin for binding, in conformity with the plan adopted for record sheets by the New York City Hospitals. Whenever the case is one of cancer of the cervix, the special sheets can be added to the patient's chart and the pertinent facts entered in due course.

A satisfactory system for recording is an important preliminary in the plan to inaugurate and unify the study of cervical cancer in various instutitions. The accompanying scheme is based on clinical study in the service at the New York City Cancer Institute from May 1923 to November 1929 during which time, all of the patients who were suffering from carcinoma of the uterine cervix, came under my supervision.

^{*} Submitted for publication December 9, 1930.

CANCER OF THE CERVIX UTERI—ADMISSION SHEET: Page 1 CANCER OF THE CERVIX UTERI—ADMISSION SHEET: Page 1 CANCER OF THE CERVIX UTERI—ADMISSION SHEET: Page 1 Record No Record Reco
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Complete Diagnosis on Admission.....

CANCER OF THE CERVIX UTERI-ADMISSION SHEET. Page

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Was the diagnosis determined by clinical examination, operative findings, or tissue section?................. What diagnosis was made?

Total milliampere hours received (M.A. hrs.)?.....Total time-span through which x-ray treatments were distributed?.....Total milliampere hours divided by total time-span in days, gives the daily average M.A. hrs. of x-ray treatment received—the treatment previous x-ray treatment?.... Form of x-ray application?........ distribution index (X.D.I.)?..... Any

curic hours divided by total time-span in days represents the radium treatment distribution index (R.D.I.)?..... Any

CLINICAL STAGE OF THE GROWTH ON ADMISSION.

Carcinoma of Cervix 1—the lesion is confined to the cervix as determined by speculum, sound, and rectovaginal examination....... Carcinoma of Cervix 11—the limits of the cervix have been reached.......

Extension to corpus?.... Extension to vagina—distance from introitus in inches, stated clockwise at four cardinal points?....

Extension to sacrouterine ligaments—Ext. right S.L., left S.L.?.. Cervix completely fixed?... Sacral nerves involved?

Is a vesicovaginal fistula present—Carcinoma of cervix 111 with V-V.F.? Hydronephrosis?.....

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CANCER OF THE CERVIX UTERI—REVISION SHEET. Page 1	Date of Revision	Findings at operation?	Clinical Diagnosis verified by operation findings? by tissue section? Cautery—Date What method used?	X-ray—Date. Porm of x-ray application. Dates and M.A. hours received?.	Total milliampere hours received?Total time-span through which x-ray treatments have been distributed?Total milliampere hours divided by total time-span in days, represents the treatment distribution index (X.D.I.)?	Total millieurie hours received? Total time-span in days through which the radium treatments have been distributed? Total millieurie hours divided by total time-span in days, represents the radium treatment distribution index (R.D.I.)? Other Methods—Date.

NEW SERIES VOL. XIII, No. 2	Neel—Cervical Carcinoma	American Journal of Surgery 207
CaseName	astitution	r
Total Therapy Op.? Result to date——Cured?	X.D.I.?R.D.I.? Improved?Unimproved?Died?	•••••
PPLEMENTARY HISTORY OF NEOPLASTIC DISEASE. Hemorrhage—DateQuantity?Frequency?	Retention of urine? Dysuria? Incontinence, urinary (V-V fistula?)? Constipation? Dyschezia? Incontinence fecal (R-V fistula?)? Complaints referable to remote metastasis? Other complaints? INICAL STAGE OF THE GROWTH ON REVISION. Carcinoma of Cervix 1—the Ission is confined to the cervix as determined by speculum, sound, and rectovaginal examination. Carcinoma of Cervix 11—the Ission extends beyond the limits of the cervix Extension to corpus? Extension to vagina—distance from introitus in inches, stated clockwise at four cardinal points? Isolated vaginal deposits? Extension to broad ligaments—Ext. right B.L., left B.L.?. Extension to sacrouterine ligaments—Ext. right S.L., left S.L.?. Corvix completely fixed? Sacral nerves involved?	Hydronephrosis? Parametritis septic active? Secondary pyometra? Parametritis septic active? Does a rectovaginal fistula exist—Carcinoma of cervix 111 with R-V.F.? Is a vesicovaginal fistula present—Carcinoma of cervix 111 with V-V.F.? Chloro-anemia—slight (FIb 70), moderate (FIb 50), severe (FIb 30)? Toxemia degree estimated from extent of bacterial invasion of lesion and symptoms—mild, moderate, severe? Complete diagnosis on revision.

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Date of Summary Name RESULT OF TREATMENT. A. Clinically Cured? Free of symptoms and signs at the time of examination?		need? yinal invasion?—distance of crater rim from introitus at four cardinal points, anteriorly, acral nerves? netra? resicovaginal fistula? Metastasis in regional lymph nodes?	

New Series Vol. XIII, No. 2	Neef—Cervical Carcinoma	American Journal of Surgery 269
Summary SheetInstitution CaseNameSum Complete Diagnosis	ımary DateRecord Nu	mber
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CANCER OF THE CERVIX UTS of —SUMMARY SHEET. Page 2 strospect. Estimate of biological malignancy based on histologic type, rapidity of growth and penetration—B.M., mild, moderate, marked? Tumor anaplastic or well differentiated microscopically? Surgical risk, average? maximum? Specific reasons? Outlook for cure with surgery?	It is the growth shown itself radioresistant (r.r.)? radiosensitive (r.s.), or indifferent? Post radiation sclerosis slight, average, or pronounced, clinically or microscopically? Tendency to focal reappearance of growth after radiation treatment—marked, average, slight? Estimated time clapsed before the neoplasm was treated? Time clapsed since the beginning of treatment? Total therapy—Op.? Total therapy—Op.? Total duration of the neoplastic disease? Diagnosis complete.	Final outcome

THE RELATIONSHIP BETWEEN

APPENDICITIS AND RIGHT OVARIAN RETENTION CYSTS*

MANDEL WEINSTEIN, M.D.

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WHEN operating for appendicitis in the female, the writer has been impressed with the frequent co-

be impossible. Nor does it matter as long as the correct treatment is recognized: namely, to operate upon the patient.

Sigmoid Flexure (Displaced Upward)

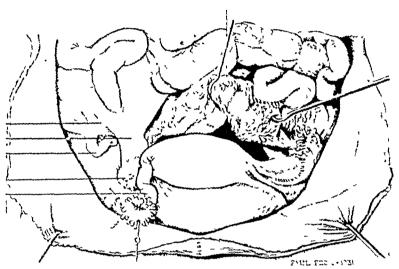


Fig. 1.

Mesoappendix Appendiculo-Ovarian (Clado's Ligment)

Vermiform Appendix

Right Ovary Fallopian Tube (Displaced Downwards)

existence of right ovarian cysts as compared to left-sided cysts. This combined pathology has occurred so often, that a study was made of 167 female patients operated upon for appendicitis at one institution over a period of two and a half years. Cases of suppurative and perforated appendicitis are not included in this study for obvious reasons. Complicating the pathological appendix, there were 23 right ovarian cysts (13.7%), in contradistinction to 4 left ovarian cysts (2.4 per cent). In many instances, an ovarian cyst was detected or suspected before operation, where the signs of appendicitis were not pronounced enough to prevent careful examination.

Bonney¹ believes that since the diseased appendix may lie in close proximity to the right adnexa, accurate diagnosis may

At the outset, let it be stated that a careful attempt was made to eliminate other pathological processes as the cause of ovarian cysts. Cases of apparent inflammatory adnexal disease have been excluded, as well as every type of ovarian tumor other than simple retention cyst. The latter consist of Graafian follicular and corpus lutein cysts.

ANATOMIC EVIDENCE

Under normal conditions, the tip of the appendix usually lies in the pelvis with the right tube and ovary, (Graves⁵). In cases of ptosis or cecum mobile, the appendix may lie completely in the pelvis, even as low as the floor of Douglas' pouch. The appendiculo-ovarian ligament, also termed Clado's ligament, (Campbell, De Lee³) is a prolongation of peritoneum in the female

* Submitted for publication December 31, 1930.

extending from the mesoappendix to the broad ligament and the right ovary. Herein is contained the appendiculo-ovarian artery which forms an anastomosis between the appendicular and ovarian vessels, thus conferring a greater vascularity upon the female appendix, a suggestive reason for its greater immunity against appendicitis in females.

Communications have been described as existing between the appendicular lymphatics and those of the broad ligament of the uterus as well as the iliac nodes. Deaver4 states that the lymphatics may empty into those of the ovary by passing along the appendiculo-ovarian ligament. In this fashion a lymphatic communication is established between the appendix and the right ovary. More recent observations, however, have failed to confirm the existence of any direct connection between these structures, (Piersol, 8 Kaufman6). Pathological conditions of the broad ligament, ovaries, and iliac nodes associated with acute appendicitis may perhaps be due to a dissemination of the infection through the subperitoneal lymphatic network by way of the appendiculo-ovarian ligament. Graves believes that this inflammatory extension from an acutely inflamed appendix may cause such serious damage to the genital organs in young girls, that among other lesions chronic thickening of the cortex of the ovaries may result. If the attack occurs before puberty, or in young children, full genital development may be curtailed, resulting in infantilism with its symptoms of amenorrhea, dysmenorrhea, neurosis, and sterility.

PATHOLOGICAL SEQUENCE

The underlying causes of retention cysts are numerous. The commonest cause, interstitial oophoritis, may be acute or chronic, (Nelson⁷). Acute oophoritis is usually secondary to an acute perioophoritis which in turn follows in the path of acute pelvic peritonitis, as in acute gonorrhea. Or it may be primarily interstitial as a complication of mumps, acute fevers,

lymphangitis of acute septic puerperal or surgical infection.

Chronic oophoritis may be the residuum

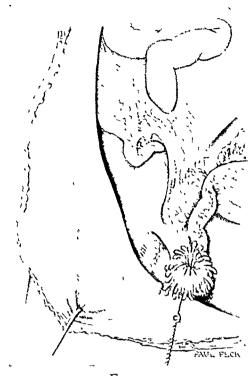


FIG. 2.

from any of the foregoing acute states, or may be chronic from the beginning. The condition is essentially inflammatory in origin, whether the pelvis is the seat of gross inflammatory lesions or not. The essential lesion consists in a sclerosing process involving the interstitial tissues. This leads to hardening of the tunica albuginea and inability of the Graafian follicles to rupture when mature. The follicular membrane undergoes hypersecretion similar to that of any serous membrane that is subjected to the chronic irritation of infection. The result is a retention cyst of any size. And a right retention cyst in the presence of appendix infection, suggests the appendix as the etiological factor.

SYMPTOMATOLOGY

No age is exempt from the presence of ovarian retention cysts. Patients in the age of puberty as well as women advanced in years may be afflicted. Our average age incidence was twenty-seven years. Nine

patients or 39 per cent were single, and 14 or 61 per cent were married. Of course, many cysts are not detected preoperatively in unmarried women, unless quite large in size. Scant flow, irregular menses, premenstrual and co-menstrual pain, and metrorrhagia may yield a clue. When a satisfactory bimanual examination is possible, right adnexal tenderness, and in further advanced cases, an ovarian mass may be elicited, in addition to the signs and symptoms of appendicitis.

Ross⁹ reported a case of a twelve-year old girl who had an ovarian cyst; the right ovary twisted on its pedicle 2½ turns. The appendix was found in a state of chronic inflammation and was likewise removed. He was of the opinion that a twist of the pedicle of the ovarian cyst had been occasioned by the active peristal-

sis of the bowel produced by an acute exacerbation of a chronic appendicitis.

CONCLUSION

- 1. A statistical analysis of 167 cases of appendicitis in the female is presented, 23 of which showed upon operation, right ovarian retention cysts in contradistinction to only 4 left-sided cysts.
- 2. An anatomic relationship exists between the appendix and right ovary, whether due to the normal proximity of the organs or to lymphatic and vascular pathways.
- 3. Chronic oophoritis resulting from appendiceal infection causes a sclerosing of the tunica albuginea, failure of the follicles to rupture when mature, hypersecretion of the follicular membrane, and the resultant retention cysts.

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- *Continued from p. 290.

SUBPERITONEAL CHOLECYSTECTOMY

PRELIMINARY CLINICAL REPORT OF A NEW METHOD*

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BOSTON, MASS.

THE aim of modern surgical technique is to accomplish its purpose with the least possible damage to the tissues. By careful, patient employment of available methods of diagnosis the lesion should be located and defined; then it should be handled by direct, specific methods. Such an ideal is not always possible of attainment, but through well directed effort it is becoming more so. An attempt in this direction has been made in the technique to be presented for cholecystectomy.

In 1899 Doyen first removed the gall subperitoneally and through the resulting peritoneal sac. This was done with an abdominal incision of the usual length and with gauze packing for exposure. The method had the advantage of decreased risk to other structures in cholecystectomy from above downward, and furnished a tract for drainage. It is an excellent procedure for the removal of gall bladders from which the serosa will strip readily. It can be done with safety through a much smaller incision than removal from below upward, starting the dissection at the cystic duct.

The method to be described uses the principle of subserous resection through an opening in the abdominal wall just large enough to deliver the fundus of the gall bladder, avoiding the necessity of packing for exposure. Experimental results on dogs have been published.^{1,2} The method was so effective in these animals that no contraindication could be seen to its use in the clinic. The success of its application is indicated in the following pages.

The first essential is to locate the gall bladder accurately; the next is to be certain

that the gall bladder is the only organ involved; and finally to determine that its serosa will strip readily. This knowledge is obtained by study of the case through history, laboratory tests, etc., but chiefly by x-ray examination. Given certain cholecystographic signs with a consistent history, negative gastrointestinal series by x-ray, normal icterus index, urine, and blood, we can be almost sure that the gall bladder is the seat of the disturbance and that it is not firmly adherent to other viscera.3 If the study has been diligent we are justified in removing the gall bladder without exploration of the abdomen. The criterion for determining that the serosa will strip readily is pronounced reduction of the cholecystographic shadow after a fat meal. Reduction^{4,5} depends upon contraction of the intrinsic musculature of the gall bladder. If this is pronounced there can be no sclerosis and thus no abnormal adhesion of the serosa to the visceral wall.

A two inch abdominal incision is made, not over the fundus of the gall bladder, but, as near as may be estimated from the x-rays and percussion of the liver, over the cystic duct, because this is the least movable portion, to which there should be a direct approach. This will generally be from a point just below the costal margin and about one inch to the right of the midline, splitting the rectus muscle. Small abdominal-wall retractors are inserted, opening the wound. If the fundus of the gall bladder is not located at once it can be found readily enough, with the aid of a ribbon retractor, to the right of the opening. It is grasped with a soft intestinal clamp or an Allis clamp and, since it is usually movable, is pulled up into the wound.

^{*} From the Surgical Clinic of the Massachusetts Memorial Hospitals, the Evans Memorial, and the Department of Surgery, Boston University School of Medicine. Aided by a grant from the Committee for Scientific Research of the American Medical Association. Submitted for publication November 28, 1930.

If this cannot be done the technique cannot be employed. Then a triangular-tipped Collins clamp (Fig. 1) is applied to the

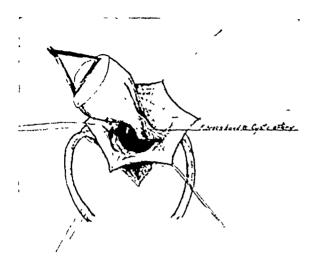


Fig. 1. Subperitoneal resection of gall bladder through incision just large enough to deliver fundus. It is grasped by a triangular-tipped clamp, pulled up, a circular incision made through the peritoneum; and then the peritoneum, retracted by stay sutures, is dissected away from gall bladder to cystic duct. Note strand of fibrous tissue carrying main branch of cystic artery, which is dissected away and tied.*

fundus. A small self-retaining retractor is placed to hold the wound open. With a very sharp knife, and fine, curved, dissecting scissors a circular incision is made just below the clamp through the serosa and subserosa to the muscular wall of the gall bladder. With a suction dissectort the serosa and subserosa are stripped downward and away from the gall bladder wall for about 1 to 2 cm. At this stage a sterile sheet with a small opening is placed over the whole field, with the fundus of the gall bladder protruding through the opening. From six to eight traction sutures are placed through the edge of the dissected peritoneal cuff and tied, leaving one long end which is clamped to the draping sheet. Then with the suction dissector and dissecting scissors the peritoneal coat is peeled off the gall bladder, and the gall bladder is dissected away from the liver

† This instrument was invented by Dr. Clifford B. Walker for removal of tonsils.

bed down to the cystic duct. A long narrow stiff-bladed retractor and a focusing head-light give good vision. As the dissection proceeds, tough strands of tissue will be encountered, running vertically, which bind the serosa to the gall bladder. These strands carry the cystic artery or its branches (see Fig. 1). Generally they can be dissected away from the gall bladder, and clamped and tied if necessary; or a Cushing silver clip can be applied; or the tissue in the strand with the artery can be coagulated by electrosurgery.

As the region of the cystic duct is approached a large strand is encountered, usually on the upper mesial aspect, which contains the main branch of the cystic artery. This should be dissected from the gall bladder high up, secured and cut there. Then it can be readily separated from the gall bladder with the peritoneal coat. As the strand containing the artery is dissected from the cystic duct the folds in the duct straighten and the gall bladder is gradually delivered. The cystic duct is then easily followed to the common duct. A tie is placed about a centimeter from the common duct, and the gall bladder removed. Care should be taken not to pull up the common duct and tie that. Blood that flows during dissection is removed by the sucker from the peritoneal sac. Occasionally the cystic artery breaks loose, but the field can be kept clear by the sucker and the vessel clamped, or clipped with a Cushing silver clip. The artery, however, is usually secured higher up and dissected away. A serious hemorrhage has never occurred. This principle of dissecting the cystic artery away from the gall bladder and securing it high up is an excellent one to follow whether doing a cholecystectomy from above downward or from below upward. There is less danger of injury to an abnormally placed hepatic artery or bile duct.

After the gall bladder is removed a medium sized catheter is placed in the peritoneal sac, which is tied around it at the top, moderately tightly with zero plain

^{*} The Author is indebted to Dr. Adrian Solo for the drawing shown herewith.

catgut, the traction sutures being cut away. The abdominal wound is closed in the usual manner.

the peritoneal sac. If placed in the sac it is removed after one to three days; if in the duct, after five to seven days.

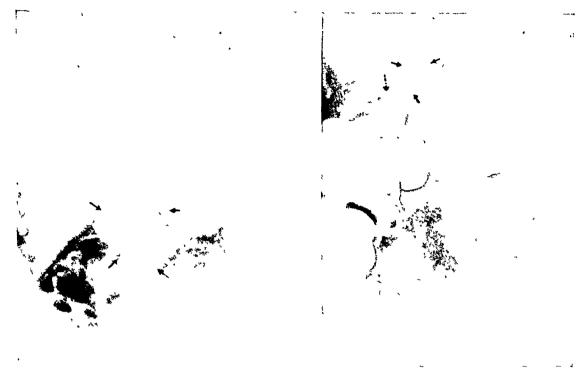


Fig. 2. Fig. 3.

Fig. 2. Case i. Cholecystogram showing a well filled gall bladder with two shadows characteristic of stones.

Fig. 3. Case i. Gall bladder has contracted markedly after a fat meal, indicating a non-sclerotic wall and a favorable case for subperitoneal cholecystectomy. Instead of two negative shadows representing stones there is one, the other having been due to gas in the colon.

An objection may be made to this technique that it does not allow exploration of the common bile duct. Careful history, laboratory tests and cholecystography should make this unnecessary. If the gall bladder fills and empties fairly well, especially if the patient has not been jaundiced for some time, there is little likelihood of a common-duct stone. But to make sure of this iodized oil can be injected into the cystic duct during the operation and its passage into the duodenum observed by x-ray. It must be remembered that instrumental exploration of the common bile duct does not always reveal stones that may be present.4 In view of this, and the increased trauma, with danger of stenosis, such exploration should be made only under definite indications.

If drainage of the cystic duct is desired the catheter may be fixed in it instead of A few cases illustrating the application of this method will be presented briefly, the technique being described only in so far as it differs from the description given.

Case I. A woman of thirty-eight, mother of two children, for four years had suffered repeated attacks of extremely severe pain in the epigastrium and right upper quadrant of the abdomen radiating to the back, associated with belching, and followed by vomiting. She had had jaundice for a short time three years before admission.

Physical and laboratory examinations were negative.

Cholecystograms showed a gall bladder which filled with opaque substance following the combined intravenous and oral method³ (Fig. 2). A combined examination of the gall bladder, stomach and duodenum was made fluoroscopically and radiographically, the patient being given a fat meal mixed with barium.³ The stomach and duodenum were negative, no

adhesions being apparent between them and the gall bladder. The vesicle emptied slowly, requiring a second fat meal eight hours after before admission, without other digestive disturbance, or jaundice. Physical and laboratory examinations were negative.



Fig. 4. Fig. 5.

Fig. 4. Case 11. Cholecystogram showing clearly outlined shadow of the gall bladder with fine mottling characteristic of stones.

Fig. 5. Case 11. Pronounced contraction of gall bladder after a fat meal, evidence that the serosa will strip away readily, a condition essential to subperitoneal cholecystectomy, and the same mottling as in Fig. 4, confirming diagnosis of stones.

the first. Finally the shadow of the vesicle was reduced to a small size and was seen to contain a negative shadow about 1 cm. in diameter representing a stone (Fig. 3). Thus the gall bladder was found to be diseased, though the pronounced contraction indicated a non-sclerotic wall with a serosa which would strip readily.

Cholecystectomy was performed according to the technique previously described. One stone was found 1.5 cm. in diameter; the mucosa was intact, but the wall showed slight evidence of chronic and early acute inflammation.

The drainage tube was removed the first day after the operation; the patient sat up out of bed the sixth day; and went home the eleventh. Fifteen months after the operation she had had no symptoms.

Case II. This patient, a woman of twentysix, had had several typical attacks of biliary colic following the birth of a child one year Cholecystograms in this case showed a good gall bladder shadow with definite, constant mottling indicating stones (Fig. 4). There was about 80 per cent decrease in size after a fat meal (Fig. 5). The gall bladder was freely movable under the fluoroscope and simultaneous gastrointestinal examination showed a normal stomach and duodenum, separable from the gall bladder, indicating no adhesions.³

Contraction of the gall bladder and absence of adhesions indicated a thin wall with a serosa which would strip readily; the history and gastrointestinal examination indicated no disease outside the gall bladder; consequently this was a suitable case for subperitoneal cholecystectomy.

The operation was performed under novocaine anesthesia, the peritoneum being infiltrated over the vesicle. Traction on the gall bladder produced discomfort, and there was some pain during dissection about the cystic duct, which increased upon clamping the duct.

Numerous small stones were found in the

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gall bladder which was thin-walled and the seat of cholesterosis of the mucosa, with mild chronic cholecystitis.

been jaundiced, we felt sure there was no obstruction of the common bile duct. But since it was feared that operative manipulations



Fig. 6. Case iv. A good shadow of the gall bladder containing several negative areas presumably due to stones.

The catheter was removed the second day after the operation. The patient was out of bed the fifth day, walking about the seventh day, and back at work the fourteenth day. A year after the operation she had had no recurrence of symptoms.

Case III. This patient, a woman of thirtytwo, with no children, had had several attacks of typical biliary colic without jaundice. Cholecystograms showed a contractile gall bladder containing small stones. X-ray examination of the gastrointestinal tract was negative. This, then, was a favorable case for subperitoneal cholecystectomy.

The operation, under amytal anesthesia, was carried on as described until the cystic duct was reached. This was found packed with small stones. Since the patient had a gall bladder which filled and emptied, and had never



Fig. 7. Case iv. Moderate contraction of gall bladder after a fat meal, delayed twenty-four hours, probably on account of blockage of cystic duct by a stone (arrow).

had forced some of the stones into the hepatic duct, the cystic duct was opened, the stones removed or crushed with a small clamp, and a small catheter placed in the cystic duct, being tied with a catgut stitch.

Drainage of bile through the catheter was free for two days, and then stopped. The tube was removed after a week by retracting a little daily.

This patient developed a pain in the right flank with tenderness over the right kidney and pus cells in the urine. Cystoscopy showed a right chronic pyelitis. Three months after the operation she was gaining in weight, without recurrence of biliary symptoms. Discomfort in the right flank was improving, although a moderate amount of pus in the urine persisted.

Case IV. A woman of thirty-five, mother of two children, nine months before admission

began to have soreness in the right upper quadrant of the abdomen, followed after a time by recurrent attacks of severe pain resembling

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sat up in a chair the seventh day and was walking about the tenth day. Five months after the operation she had been entirely well.



Fig. 8. Case vii. Dense shadow of gall bladder with few negative spots at fundus suggesting stones.
Fig. 9. Case vii. Moderate contraction of vesicle, somewhat delayed, with persisting negative shadows at fundus, confirming diagnosis of stones. Contractility of vesicle, with mobility under fluoroscope, indicated that a subperitoneal cholecystectomy could be done. But this was prohibited by conditions shown in Figs. 10 and 11.

biliary colic. There was no history of jaundice. Her appendix had been removed five years previously.

Cholecystograms showed a good gall bladder shadow with 5 or 6 negative shadows about 8 mm. in diameter representing stones (Fig. 6). Barium-fat meal (egg yolks and cream mixed with barium)³ showed normal stomach and duodenum with no adhesions to the gall bladder. The vesicle contracted to about half-size and then stopped for twenty-four hours, probably due to a blocking of the cystic duct with a stone (see Fig. 7).

The contractile non-adherent gall bladder permitted subperitoneal cholecystectomy, performed according to the technique described, the catheter being placed in the peritoneal sac. Five stones 7 to 8 mm. in diameter were found packed into the ampulla of the gall bladder, one of which was blocking the cystic duct.

The gall bladder showed slight cholesterosis and chronic cholecystitis in addition to the five mulberry cholesterol stones.

A small amount of bile drained through the catheter for two days after the operation. The patient had no postoperative distention; she

Case v. A woman of fifty-three, mother of three children, three years before admission began to have a dull pain in the right upper quadrant of the abdomen, radiating to the right scapular region, associated with slight nausea. She had never had jaundice or typical biliary colic, and had had no other digestive disturbance.

Cholecystograms showed a good gall bladder outline with a negative shadow 1.5 cm. in diameter, which was constant on subsequent plates, indicating a stone. The stomach and duodenum were normal by x-ray examination. The vesicle contracted very slowly, due presumably to blockage of the duct by the stone. Nevertheless, contraction indicated a serosa which would strip readily.

The gall bladder was removed subperitoneally through a 2 in. incision. The technique differed in only one important particular from that in the other cases. In them silver clips were used to check hemorrhage from the cystic artery and its branches; here the vessel was handled in an entirely different manner. As the serosa was stripped away from the gall bladder from above downward small strands

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of fibrous tissue were encountered which contained branches of the cystic artery. These strands were dissected away from the gall

The gall bladder was removed through a 2 in. incision. Several small stones were found packed into the cystic duct, which was opened,

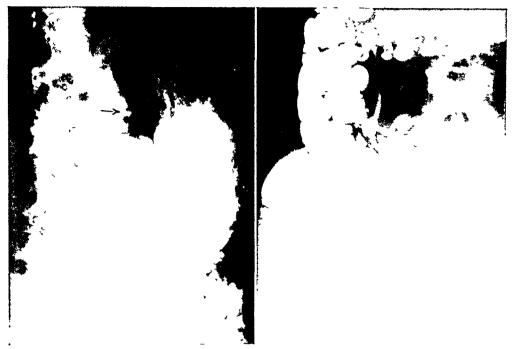


Fig. 10. Fig. 11.

Fig. 10. Case vii. Radiograph of stomach showing niche typical of duodenal ulcer on anterior wall of duodenal cap (arrow).

Fig. 11. Case vii. Radiograph of colon showing a long, fixed appendix extending from cecum nearly to hepatic flexure.

bladder as high up as possible, and either broken off or cut. There was little bleeding. Thus by dissecting away the branches of the cystic artery high up and following down close to the gall bladder the artery itself was not encountered, being pushed away with the peritoneal sac.

This patient followed the usual comfortable postoperative course, no nausea or vomiting, no gaseous distention. She walked on the tenth day and was well when seen one month after the operation.

CASE VI. A woman of twenty-two, mother of two children, for three years had had repeated attacks of biliary colic followed by jaundice, the last of which, however, had occurred several months before admission.

Physical and laboratory examinations were negative.

Cholecystograms combined with gastrointestinal series showed a good gall-bladder shadow which contracted readily after a fat meal, with several small constant negative shadows, the alimentary tract being normal. the stones being milked out after dissection of the cystic duct to the common duct. The cystic duct was tied I cm. from the common duct, the sac being drained with a catheter. The patient suffered extremely little post-operative discomfort, sat up in bed the fifth day, was out of bed the sixth day, discharged the ninth day, and the fourteenth day came back to the hospital by foot and trolley for examination, which was negative. Two months after the operation she was well.

Case vii is given to illustrate the situation in which subperitoneal cholecystectomy with a small incision should not be done.

A woman of forty-two, mother of four children, three years before admission began to have distress in the right upper quadrant of the abdomen associated with belching of gas, aggravated by greasy foods, and punctuated by attacks of biliary colic, one of which was followed, five months before admission, by jaundice lasting three weeks. There was no hunger-pain; no relief of distress from food or soda; in short no history of peptic ulcer.

Cholecystograms showed a good image of the gall bladder containing several negative shadows 5 mm, in diameter, indicating stones (Fig. 8). After a fat meal the vesicle very slowly contracted to one-fourth its original size, the negative shadows remaining constant (Fig. 0). Contractility to this extent indicated that a subperitoneal resection could be performed. However, following our usual custom, a gastrointestinal series was done. It revealed duodenal ulcer (Fig. 10) and probably a pathological appendix (Fig. 11).

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A regular abdominal incision was made, the ulcer resected, a Finney pyloroplasty performed, and the gallbladder removed subperitoneally from above downward according to Doyen's technique. To avoid excessive operative shock the appendix, which was not severely diseased and was difficult of access, was not disturbed. In this case it would have been a grave mistake to have removed the gall bladder through a small incision and left an active duodenal ulcer. The history of jaundice here was also a deterrent, though it need not preclude the operation in question if the jaundice has occurred some time previously, if the gall bladder fills and empties normally, and repeated tests for icterus are negative.

SUMMARY

- 1. The clinical application of a new method for subperitoneal cholecystectomy is presented, by which the gall bladder is removed from above downward through an abdominal incision just large enough to deliver the fundus.
- 2. The indications for this technique are (1) a non-sclerotic, non-adherent vesicle from which the serosa will strip readily, and (2) limitation of disease to the gall

bladder. These conditions are determined by history, laboratory tests, cholescystography, and gastrointestinal x-ray examination.

- 3. The disadvantages of the method are: a longer operating time, and the necessity for expert dissection and handling of tissues.
- 4. The advantages of the method are: smaller abdominal incision, with a minimum of reaction and discomfort about the wound and damage to the abdominal wall; diminished shock and trauma to viscera, with lessened postoperative distress, more rapid convalescence, fewer adhesions, and a reduction of operative risk.

Note: Since this article was submitted for publication the author has employed the technique described in seven additional cases, with results comparable to those given.

Subserous resection of the gall bladder according to Doyen's technique has been performed by Dr. Egbert L. Mortimer, St. Agnes Hospital, Baltimore, Md. in 50 cases without a fatality. There was a minimum of operative shock, rapid and comfortable recovery without nausea and pain, and excellent late postoperative results. See Am. J. Surg., n. s., 6: 83, 1929.

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TOXINS OF HIGH INTESTINAL OBSTRUCTION*

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ME chemical work which has been reported in connection with the preparation of the toxic material and other constituents derived from the contents of an isolated loop of intestine in dogs is such that no definite conclusions can be drawn. Nesbit¹ was able to isolate choline and another substance, which probably was neurine, from the fluid of an obstructed loop after feeding egg yolk to the dogs. Kukula² showed the presence of a diamine, probably cadaverine, in the fluid above an obstruction. These compounds are, however, not toxic enough to account for the usually fatal action of the loop contents. Sweet, Peet, and Hendrix³ found in the fluid from an occluded loop a proteose and choline-like substance. Gerard4 suggested that the toxin might be a peptamine containing histamine.

Perhaps the most extensive work on the chemical nature of the toxic material has been carried out by Whipple and his associates.⁵ They have been successful in isolating from the contents of an obstructed loop a toxic fraction which they claim is a proteose-like body. Sugito⁶ has confirmed the work of Whipple and his associates in many respects. He claims to have been able to obtain the poisonous material in crystalline form with platinum chloride.

We took up the investigation in order to isolate the different constituents present in the contents of an occluded jejunal loop of dogs in the hope of throwing more light on the processes of intestinal obstruction. In preparing the loops we were careful always to take the highest possible segment of jejunum. The loops were washed thoroughly so that all food, worms, and gross foreign material were removed. The ends were inverted with the minimal amount

of damage to the mucosa. With these precautions we found that some of the animals would become critically ill and die within forty-eight hours, whereas others would live for six or seven days before showing signs of toxicity. Bacterial cultures were taken from the loops, and there was great variation in the flora of the loops of different dogs. It was our intention to isolate the substance or substances which are mainly responsible for the toxic action of the contents of a closed loop, in a pure crystalline form, in order to find out its chemical composition. In spite of the fact that we have not been successful in this respect we think it worth while, nevertheless, to report briefly our results, especially as our procedure in obtaining the toxic fraction differs somewhat from the method employed by Whipple and his associates. We have also repeated the work of Sugito6 and shall comment on it later in our paper. Our findings may be of help to those who are still engaged in this field of research.

In following the directions given by Whipple and his co-workers for the isolation of the toxin we found a great disproportion in the yield of toxic material and the toxic strength of a given volume of the loop content. Sometimes we were not able to obtain a toxic material which was soluble in water as stated by Whipple for his product. We found, to our great surprise, that the toxin becomes gradually insoluble in water during the isolation process. It is a well known phenomenon that some water soluble proteins or substances closely related to them gradually become insoluble in water by frequent precipitation with alcohol. Probably we are dealing here with the process of denaturation. We found, however, that the toxin, in-

^{*} From the Departments of Pharmacology and Surgery of the Johns Hopkins Medical School. Submitted for publication November 7, 1930.

soluble in water, is readily soluble in weak alkali, and we therefore employed an alkaline solution in the later stages of the isolation of the toxin. Ingvaldsen, Whipple, Bauman, and Smith's stated that alkali was used in order to obtain a clear solution of the toxic substance.

Our procedure in obtaining the toxic fraction may be briefly outlined. The loop content was mixed with twice the amount of 96 per cent alcohol and allowed to stand over night and centrifuged, alcohol solution i, and the precipitate was then extracted three times with 20 c.c. of water in the cold. The aqueous solution, generally not a clear one, was heated to boiling for three minutes. After cooling, the formed precipitate was centrifuged off and extracted twice with 10 e.c. of water. The combined aqueous solutions were evaporated to about 20 c.c. in vacuo and then 150 c.c. of 96 per cent alcohol were added. The precipitate, the formed product of Whipple, was centrifuged off, and washed with alcohol and ether. The alcoholic solution it was combined with the first one. We have found quite frequently that water will extract only very little from the precipitate, but as soon as the solution is made faintly alkaline with sodium carbonate, solution occurs. These alkaline solutions contain the toxin, as has been shown by numerous experiments with dogs. On acidifying the alkaline solution with acetic acid the toxin is thrown out again. The properties of this product agree very well with those stated by Whipple and his co-workers for their product, except the solubility in water. Attempts to purify this product to the crystalline state have so far been without success.

From the alcoholic solutions 1 and 11 we were able to isolate cadaverine and histamine in the form of a picrate. Histamine was also detected by its pharmacological properties. Furthermore, we found good evidence for the presence of choline, which was isolated as a mercury chloride salt, and was also demonstrated by its action on the blood pressure before and after injection of atropine. There is no doubt that this alcoholic extract of the loop content also contains basic constituents other than those mentioned. Compounds like histamine and choline might play a rôle in rendering the toxin (albumose) absorbable from the lumen of the intestinal loop. In isolating these substances from the alcoholic solution we employed well known methods, and it would lead too far to give the details here.

We may also mention here that the copper chloride salt isolated by Sugito from the loop content is in all probability choline, as it was found by us to have the typical pharmacological properties of choline or of a compound very closely related to it.

In addition, we would like to comment on some experiments in which the bacterial flora present in the loop were cultivated on broth media from which we isolated, by the method described here, a toxin which seems to have nearly the same properties as the toxin obtained directly from an isolated loop of intestine.

The impression gained by us from our work on the contents of an isolated loop of jejunum in dogs is that it seems that the composition and toxicity of the contents vary widely. Sometimes we had no trouble in obtaining a choline fraction; at other times we could detect only very little. The same was true with cadaverine and histamine. We are also inclined to believe that the chemical composition of the toxin itself varies, depending on the nature of bacteria present in the loop. If this is true, it would be rather difficult to isolate a chemical unity from the loop contents of several obstructed dogs.

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MALIGNANT ADENOMATA OF THE COLON*

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HISTORICAL

THE first mention of a probable case of malignant adenomata of the colon was by Menzel in 1721 in a congenital type of case, in a boy of fifteen years. Wagner reported a case in 1832, Rokitansky reported a case in 1839 of multiple adenomata. The first to describe the polyps themselves was Lebert in 1861, and in the same year Luschka²⁵ described a case in a female thirty years. Virchow³⁵ reviewed the cases of Lebert and Luschka, and called the condition, "Colitis polyposis cystica." Von Port collected 14 cases and in 1907 Doering collected 35 cases from the literature. Since that time numerous cases have been reported by the following: Soper, 33 8 cases in 1916; Struthers, 35 39 cases in 1920; Struthers, 36 in 1924, 20 cases from the Mayo Clinic, Saint in 1927 in the British Journal of Surgery made a very complete and exhaustive study of the condition. Lockhart-Mummery²⁴ in 1928 contributed to the literature the fact that it was a forerunner to malignancy. Hullsiek¹⁷ 1928 reported a case with a tabulation of the cases up to this time. Since then there have been case reports by Kuhn and Helwig, 20 Tonnesen, 37 and Stewart. 34

FAMILIAL TENDENCY

Mummery²³ thinks the condition to be a congenital one, as many cases can be traced in the same family, and through several generations. In this case the mother died of an "inoperable" malignancy of the sigmoid. A larger percentage of the patients die in early life and die of malignancy. Cripps saw 3 cases in the same family. Jungling reports 15 cases in three generations, Hullsiek¹⁷ reports a case similar to this one whose brother died of the same condition at the age of thirty-four years; the father died at the age of forty-four

of bowel trouble. There are many other reports of similar cases in the same family tree, by Dukes, 10 Jungling, 18 Mummery, 24 Hullsiek, 17 Saint, 32 Tonnesen. 37

ETIOLOGICAL FACTORS

The etiological factors leading to polypus formation is certainly still in an uncertain state and very little information can be obtained from the literature as to their cause of formation. There are three theories:

(1) inflammatory; (2) that concerned with primary epithelial change; and (3) congenital.

The inflammatory theory may be supported by the frequent small, round cell lymphocytic infiltration found on examining the slides, the preponderance of the formation of polyps in the distal colon, sigmoid, and rectum. These segments of the colon are most liable to inflammatory changes. Bardenheuer and Hauser 16 believe the change takes place in the epithelium of normal glands and that the inflammatory changes are secondary in nature. Bardenheuer believes that the development of tumors in places in the bowel most liable to irritation is only significant in their further development.

Another factor in favor of the second theory is that all the mucous membrane in the surrounding tissue of the adenomata examined showed no signs of any inflammatory reaction but was apparently normal. This has also been observed by Quénu, 30-31 Landel, Hauser and Bardenheuer. Undoubtedly they start with a hypertrophy and hyperplasia of the glandular tissue at a certain point, causing a thickening of the mucosa and a small fold. As this increases in size a small pedicle is formed and in due course of time the pedicle becomes elongated. The larger polyps and longer pedicles are only exaggerations of the

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smaller hyperplasia. Histologically they are identically the same. The theory in regard to the increase in size of the polyps still

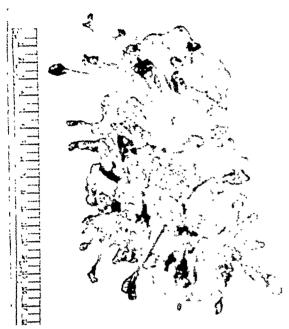


Fig. 1. Area of adenocarcinoma with numerous large and small polyps. Also note length of pedicles.

remains a disputed question. The third theory that they are congenital in origin can be supported by the numerous cases occurring in the same family, but different generations, and cases reported in three generations.

Age: Quénu states that 50 per cent occur between the first and third decades in life. but cases have been reported at almost any age.

Sex: The sex incidence is about equal in different series reported in the literature, 52 per cent in males, and 46 to 47 per cent in females.

Site: The location of the adenomata whether they be single or multiple depends a great deal on the accuracy of the description, and according to Saint³² they occur as follows: (1) sigmoid; (2) cacum; (3) ascending colon; (4) descending colon and rectum (the last three locations constitute 41 per cent in his series in the large bowel); (5) rectum alone, 24 per cent; (6) colon "unnamed"; (7) transverse colon. In the small bowel they occur most frequently in

the ileum, and they are very rarely pedunculated. In the small bowel it is more likely to be a glandular hyperplasia than a true pedicled polyp. Benign polypus growths have been removed surgically from the stomach, and are usually single in this location. Polyps have been of recent years reported in the esophagus, so polyps can occur throughout the entire gastrointestinal tract, but with much greater frequency in the rectum, sigmoid, and the descending colon. The size of the polyps varies considerably as in this case from a simple hyperplasia to a large pedunculated polyp.

Definition: A polyp is a pedunculated or sessile growth which projects into the lumen of the bowel, either as a result of hyperplasia or hypertrophy, of the mucous membrane, or else a benign, true tumor. For clinical purposes an adenoma may be called a glandular tumor, visible to the naked eye, and hyperplasia as a similar change only usually visible by the aid of magnification. Adenomata histologically represent only an advanced stage of

hyperplasia.

The intestinal wall is made up of several layers, mucous membrane, submucous layer, unstriped muscle, peritoneal, vascular, and connective tissue, and from these tissues various types of growths may originate and with hypertrophy may project into the lumen of the bowel and form polyps. Therefore one may find such tumors as, fibromata, lipomata, myxomata and hemangiomata, in the lumen of the bowel. The term polyps covers a large variety of tumors unless differentiated histologically.

Polyps in the Large Bowel: Polyps occur much more frequently in the large than in the small bowel. They may be found single, or multiple, throughout the entire gastrointestinal tract. The true adenoma comprises a tumor arising from the glandular epithelium, and it is the most frequent type of polyp which occurs in the bowel. The polyps vary considerably in size from a pinpoint to some as large as 5 and 6 cm. in diameter. If of a large type they are

usually single, but there may be many smaller ones also in the bowel. Multiple adenomata may either cover the mucous membrane of the entire colon or else be thickly "studded" and confined to one segment of the bowel. There have been numerous names applied to this condition, multiple polyposis, colitis polyposa cystica.

In most of the cases the histological study shows a dilatation of the glands into cyst-like spaces. This cyst-like appearance is undoubtedly caused by an obliteration of the mouths of the secreting glands, during the inflammatory stage.

In a second type of ademomata the mucous membrane has only a few polyps and they are usually pedunculated. They are usually much larger than in the other group and more likely to undergo malignant changes. In the case I am reporting, the pedicles varied from a hyperplasia to 5 and 6 cm. in length (see Fig. 1). The polyp is a shade darker than the pedicle and mucous membrane. The adenomata vary in color from a bright red, to black, many are gravish white, being covered with a thick mucous secretion. The pedicle is smooth and covered with mucous membrane, which is continuous with that of the bowel. The pedicle at its base is usually rounded, but as it reaches the end it has a tendency to become flattened out. The pedicles in the rectum are more likely to be flattened than higher up in the colon. The polyps are granular in appearance, bleed easily, many of them are smooth, depending on the amount of irritation. Some have a tendency to be lobulated. The polyps in this case in the splenic and transverse colon are smooth; in the sigmoid they are granular, lobulated, and bright red in color. This I think is due to the fact that the polyps in the sigmoid are much larger than they are in the transverse colon. The pedicle consists of connective tissue, mucous membrane and a few smooth muscle fibers, and capillaries.

The tumor part of the polyp consists histologically of glandular and connec-

tive tissue elements. The glands are mostly tubular in type and open on the surface; however, in many, the mouth of the



Fig. 2. Infiltrating tumor mass into anterior abdominal wall.

gland is closed, and the glands take on a cyst appearance. The glands are lined with a columnar epithelium and those near the base represent the glands of the mucous membrane of the bowel. The blood vessels are capillary in type, and contain a few red blood cells. In several areas there are numerous round cell lymphocytic infiltrations. The tumor portion is very loosely attached to the pedicle and is very easily detached on cleansing the bowel under running water.

The pedicle originates in the submucosa and extends upward into the tumor proper. The muscular fibers originate in the muscular layer and extend upward into the pedicle subjacent to the mucous layer and as they come closer to the tumor portion they disappear.

As the adenomatous tumors increase in size they undergo changes of clinical and histological importance, as far as the treatment is concerned. The pedunculated tumors vary in size from a pinpoint to 3 and 4 cm. in diameter. They also vary in color and consistency



Fig. 3. Tumor mass in anterior abdominal wall replacing rectus muscle.

according to location, and the amount of irritation present. The polyp is usually covered with a thick tenecious mucous secretion, and there is a large amount of mucous secretion throughout the large bowel (Figs. 1 and 4).

POLYPS AND THEIR RELATION TO MALIGNANCY

As the adenomata increase in size there is a tendency for them to become less differentiated, and it may be extremely difficult to say whether they are malignant. Cells which serve no useful physiological function except with the embryonic function of the cell proliferation, present an important question as regards their surgical treatment.

In looking for malignant changes one must search the periphery of the larger polyps, as it is here that carcinomatous changes are most likely to occur. The frequency of multiple polyposis and malignant degeneration in the literature has led surgeons and pathologists to the opinion that adenomata are capable of undergoing malignant changes. This opinion rests mostly on clinical rather than histological basis. Mummery states that whether of the single or multiple variety they show a marked tendency sooner or later to become malignant. The case here reported proves the statement.

Some writers take the opinion that single or multiple polyps are only a state of malignancy or a precancerous condition. If this be the case then we are presented with a difficult surgical problem. If with satisfactory evidence that the polyp is single and of the large variety, it can be removed surgically by opening the bowel under aseptic precautions, with cauterization or fulguration of the base, and closure. However, if there are multiple polyps extending throughout the large colon, as in this case, a more radical operation is required, and very little less than a colectomy will bring the desired results. A segmental resection, Mikulicz, and an ileocolostomy, Kraske, etc., are only in part fulfilling the required demands for relief as far as a cure is concerned. Whatever surgical procedure is carried out has a high mortality even under the best surgical treatment. To do a colectomy leaves the patient practically an invalid even if he survives the operation.

If a Mikulicz type of resection be done, one is likely to transplant some of the friable polypus tissue into the abdominal wall and the secondary growth will be disseminated throughout the abdominal wall as in this case (Figs. 2 and 3). In this case the polyps were multiple and malignant. This type of case is very rare in the literature, as most of the malignant polyps are large and single. One of the reasons given why multiple polyps do not

become malignant is that they never become large enough to undergo malignant change. The adenomata that undergo malignant change are usually 3 or more cm. in diameter. Saint reports a series of 36 cases with malignant changes in 13 per cent. The occurrence of malignancy and multiple polyps are rather rare in the same colon considering the frequency of malignancy in the large bowel.

Treatment: The only treatment of any value is surgery, and as stated previously in this article the surgical procedures are major ones, and carry a very high mortality for the beneficial effect obtained. Deep x-ray has practically little or no value in this type of lesion as shown in this case, the one of Hullsiek, and many others.

In summing up the treatment Erdman¹² has said the following:

One may sum up the present status of treatment of such a condition by saying, that the only method which holds out any hope for cure in the disseminated variety is one imposing upon the operator great technical difficulties, upon the patient great danger, and upon both the possibility that a successful operation may prove fruitless because the operator has been unable to determine accurately the extent of the growths and has therefore left behind areas capable of transmitting all the original potentialities of the disease.

CASE REPORT

H. G. M. Male, aged thirty-two, salesman. Family History: father died, aged twenty-nine, of pneumonia. Mother died, aged forty-two, malignancy of colon. Brother one, twenty-seven, living and fair health.

Past History: measles and mumps as a child. Operations: 1. Hemorrhoidectomy, 1918, for bleeding hemorrhoids. 2. Injected hemorrhoids 1920 for bleeding. 3. Lipoma from the back, removed in 1918. 4. Resection of colon 1925, for multiple polyposes.

Chief Complaint: Weakness, anemia, feeling tired, passing of blood by rectum. For some time prior to operation in 1925, patient would at intermittent intervals pass a small amount of blood when the bowels would act. On different occasions the stools would be dark in color. This kept up over a period of several

years, was told that it was caused by bleeding hemorrhoids, and had a hemorrhoidectomy. This did not stop the bleeding. Was told that

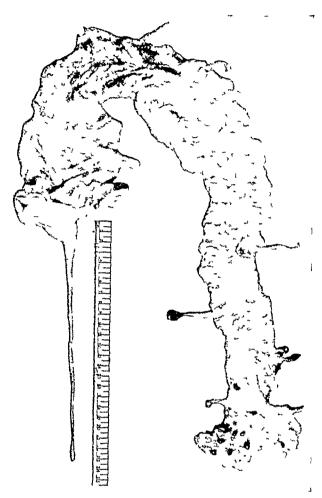


Fig. 4. Polyps extending as far as hepatic flexure of large bowel, with long and short pedicles. Grayish white areas represent mucous secretion. Note abnormal length of appendix.

the internal hemorrhoids still caused the trouble and needed them injected. This was done, but the bleeding still continued in small, irregular amounts. He passed large amount of mucus. Bowels fairly regular as he watched his diet and habits. Eats everything, no gas, burning, gnawing, etc.

Genitourinary: essentially negative. Cardio-respiratory: No cough, colds, edema, or cyanosis, etc. Examination: Fairly well developed male, appearance of a mild secondary anemia. Pupils round, regular, react to light and accomodation. Teeth excellent, Tonsils, small fibrous, no infection. Neck, essentially negative. Chest, apex normal position, loud, clear, no murmurs. Other heart sounds the same. Lungs apparently negative. Abdomen, no tumor masses, rigidity, etc. Rectal, external negative.

Internal palpation. Could not feel any induration or tumor masses. Temperature. 98.4°F. Pulse 78. Respiration 18. Blood pressure

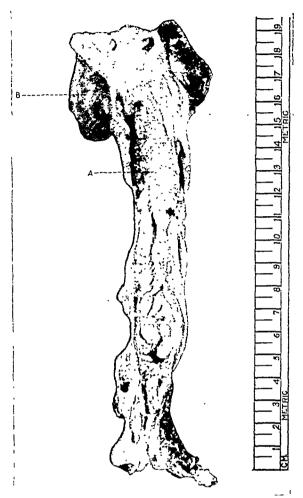


Fig. 5. Tumor mass infiltrating inferior vena cava. A.
Tumor mass. B. Liver.

120/84. Urine essentially negative. Blood, Hemoglobin, 60. Red blood count 3,200,000. White blood count 5200. Wassermann test negative. X-ray chest negative. Stool examination shows positive benzedine for blood. Proctoscopic Examination: The mucous membrane appears injected in places, with numerous polyps some with rather long pedicles, others a hyperplasia of the epithelium. At the distal point of the sigmoidscope a tumor mass consisting of numerous polyps can be seen, and these bleed very easily. Evidence of old scar from hemorrhoidectomy. X-ray of colon shows a filling defect in the sigmoid colon. Diagnosis: Multiple bleeding polyps in the sigmoid. Secondary anemia. October, 1925, a Mickulicz

resection, following a midline exploration. The second stage of the operation 10 cm. of sigmoid were resected, and the pathological diagnosis was adenocarcinoma with no glandular involvement. Patient made an uneventful convalescence but it was impossible to get the colostomy closed and he always had a small fecal fistula. Following this operation in December 1925 and January 1926 he had deep x-ray therapy in all directions. Again in June of 1926 he had deep x-ray, and x-ray again in May 1927, and last again in February 1928. From all clinical evidence the deep therapy had very little results, as a recurrence began to show up in abdominal wall in March 1927 and continued to increase in size, until the time of death. This hard, smooth mass was confined to the anterior abdominal wall. Following the operation he was given oil enemas, yeast, iodine, kaolin, salol, and many other so-called bowel antiseptics without any beneficial effect.

He gradually became weaker and was practically helpless in December 1927 although he did not enter the hospital until June 1928, and died December 6, 1928.

Autopsy: Died Dec. 6, 1928, 9:30 A.M. H. G. M. autopsy by E. M. Hall, pathologist St. Vincent's Hospital. Male. Aged thirty-two, single. Salesman. Length, 5 ft. 8 in. edema III of the thighs, genitalia, abdomen, chest up to a level of the third rib and the forearms. Emaciation III. Eyes sunken. Pupils dilated round, regular.

Half the distance between the symphsis and the umbilicus there is a colostomy opening measuring 6 × 4 cm. and deep enough to lose a hemostatic forceps. On looking into the colostomy opening one sees a granular appearance, grayish white in color and studded with polyp-like tissue. The colostomy is surrounded by a board-like hardness which is fixed in the abdominal wall. The lower one-half of the abdomen is also infiltrated with this board-like hardness and it extends laterally to the anterior superior spine of the ilium. On cutting through the abdominal wall the infiltrating tissue measures 10 cm. in thickness on the left side of the colostomy, and 5 to 6 cm. on the right side of the colostomy (see Fig. 2).

The colon extending into the colostomy is infiltrated and surrounded with malignant tissue. The portion of the sigmoid above the colostomy for 15 cm. is involved along the mesenteric attachments.

The stomach is dilated and contains 300 c.c. of foul smelling, dark colored liquid material. On opening the stomach the mucous membrane is pale, and somewhat edematous. There is no break in the mucous membrane.

Duodenum: No ulcerations or scars. Apparently negative. The rest of the small bowel and mucous membrane is pale, and in places there appears to be areas of hyperplasia. Throughout the small bowel there is a thick, tenacious material light yellow in color, and it is easily removed by washing under the tap. Appears to be bile-stained mucus. The cecum is dilated and freely movable. The appendix measures 23 cm. in length, is free and shows no evidence of any adhesions. It has a long free mesentery (see Fig. 4).

The ascending colon as far as the hepatic flexure appears normal, except for an edematous appearance, beginning in the middle third of the transverse colon (see Fig. 4). There are numerous polyps, both with and without a pedicle.

As one goes to the splenic flexure, descending colon and sigmoid the polyps increase in size and number, and on palpating the wall of the bowel there is a feeling of resistance that is not in the wall of the bowel where the polyps are not so numerous. Throughout the colon there are numerous areas of hyperplasia of the epithelium, and these are more abundant in the distal descending colon, and sigmoid (see Fig. 4). The sigmoid colon was deflected in the right lower quadrant following the operation, by the extrinsic pressure of the tumor mass in the abdominal wall.

The mucous membrane of the rectum is very edematous, and injected with many small polyps, also some areas that appear to be scars from cauterization. No ulcerations. The sigmoid is one solid mass of polyps varying in size from a pinhead to the size of a large hazel nut (Fig. 1). Some of the polyps have pedicles that measure from 2 cm. to 5 to 6 cm. in length (see Fig. 1). There is a solid polypous mass in the sigmoid measuring 4×5 cm. which has the appearance of carcinoma (Fig. 1). This polypous area was attached to the anterior abdominal wall at the site of the colostomy. The polyps vary in color from a bright red to a black and gray. There are no lymph nodes involved that we are able to make out.

Pleural cavities contained about 1200 c.c.

of light straw colored fluid. There are no pleural adhesions and no scars at the apex. No calcified lymph nodes at the hilus of either lung. The lungs are almost completely collapsed.

The heat weighs 200 gm. Small valves appear normal, no sclerosis, or vegetations. Chambers normal. Musculature dark red, and firm. Coronary arteries apparently normal. Aorta normal.

Spleen: Weight 80 gm. Small, firm, dark red in color, and resists section. On cut section the trabeculae are prominent, also the Malpighian bodies. Adrenal: Apparently normal.

Kidneys: Right 100 gm. capsule strips easily, light gray color, pyramids prominent. Pelvis appears to be normal. Left, weighs 125 gm. Otherwise the same.

Pancreas weighs 200 gm. firm, nodular, no tumor masses. No adhesions.

Liver weighs 1500 gm., surfaces smooth, light red in color, no tumor masses. On cut section light yellow in color, showing fat replacement of liver tissue. The edges are sharp, fibrous tissue prominent.

The gall bladder is distended with a thick, greenish, black bile, no stones. About 10 c.c. of bile. The mucous membrane of the gall bladder appears thickened, otherwise normal. Gall-bladder ducts patent, no stones.

The inferior vana cava extending from the union of the iliacs to where it joins the liver is filled with a hard, light, yellow growth which is very adherent to the wall of the veins. This growth extends up to a point where the vein enters the liver (Fig. 5). There is also tumor tissue extending into the common iliac veins and from other small veins which join the inferior vena cava.

The prostate is small and firm, and is not involved in the tumor mass. The urinary bladder is small. The mucous membrane is very edematous and injected showing evidence of inflammation, particularly about the trigone. The tumor mass surrounds the bladder, has invaded under the symphysis and into the space of Retzius. Also has spread into the lateral walls of the pelvis into the muscular tissue. There are no diverticula in the urinary bladder. The tumor mass in the pelvis is of the same hardness as that in the abdominal wall.

CONCLUSION

1. An unusual case in which multiple adenomata of the large and small variety

have undergone malignant changes is reported. The polyps vary in size from a simple hyperplasia to 5 and 6 cm. in diameter, and with pedicles up to 6 cm. in length.

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- 2. Recurrence occurred at the site of the old operation, and about the colostomy opening, as a result of transplanted tissue from the Mickulicz resection and not removing enough of the colon.
- 3. Adenomata in the colon and secondary implants in the abdominal wall are very resistant to deep x-ray therapy.
- 4. In a very large percentage all single adenomata are malignant, while in the

multiple type they may become malignant. if they increase in size, sufficient to undergo malignant changes.

- 5. Adenomata occur most frequently in the large bowel; they occasionally occur in the small bowel, and may occur throughout the gastrointestinal tract.
- 6. All adenomata are potentially malignant and the type of operation, and postoperative treatment should be left to the surgeon, and individual case.
- 7. Malignant changes begin in the periphery of the larger polyps and rarely occur in the smaller ones.

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INTERDUODENAL FISTULA*

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A acute perforated peptic ulcer, in the great majority of cases, requires early surgical attention or diffuse peritonitis will result with a fatal termination.

In an occasional case the perforation will become plugged with a piece of omentum or some adjoining organ such as the liver, gall bladder or intestine. The opening may become sealed, and recovery take place, or the perforation may extend into the contiguous organ with varying effects, depending upon the viscus involved. If the viscus be the stomach or intestine, a fistulous tract may become established, which may persist for an indefinite length of time. Cases of this kind are rare and consequently of interest. In the following case a fistula was discovered leading from the first portion of the duodenum to the third portion, producing an interduodenal fistula.

REPORT OF A CASE

History: Mr. J. I., aged forty, was referred by Dr. John Ruddock for a surgical opinion in March, 1928. The patient complained of attacks of pain in his upper right abdomen. These attacks began shortly after a right nephrectomy four years prior to admission. This operation was done for a calculus pyonephrosis, and was performed with great difficulty. The pain was described as being severe, appearing suddenly, and of indefinite duration. It was usually worse at night. It had no relation to meals, although at times it was relieved by a large amount of food. The patient had nausea but no vomiting. No blood was noticed in the stools. There was moderate loss of weight. The attacks gradually became worse, until he was unable to attend to his work.

He was observed and treated by a number of doctors but obtained no relief. In June, 1927, his abdomen was explored and a chronically inflamed appendix was removed. The attacks of pain persisted unchanged and no definite diagnosis could be established.

The past history was clear except for a left nephrotomy for renal calculae in 1917.

Examination: Examination revealed a muscular individual with a normal blood pressure, pulse, and temperature. The abdomen showed a long right rectus scar and there was moderate tenderness in the upper right quadrant. There were operative scars in both lumbar spaces. The remainder of the examination was essentially negative. The blood count, urine, blood Wassermann test and stool were negative.

The radiological studies by Dr. Davis solved the problem. A summary of his findings showed a constant deformity of the duodenal cap on the lesser curvature side. In addition there was either an accessory loop of bowel, a fistula, or a penetrating ulcer, extending from the first portion of the duodenum to the third portion.

On the basis of these studies an operation was advised which was performed by Dr. C. G. Toland.

Operation: The stomach and duodenum were exposed through an upper right rectus incision. There were many adhesions and marked induration about the pylorus. A fistula was discovered about ½ in. distal to the pyloric ring, which led downward and into the third portion of the duodenum. This tract was shaped like an inverted cone and was composed of scar tissue. It evidently was the result of an ulcer which had perforated from the first to the third portion of the duodenum.

The fistula was excised and the two openings in the duodenum were closed. There was considerable narrowing of the duodenum, so a posterior gastroenterostomy was deemed advisable. The wound was closed to a Penrose drain.

Aside from a moderate postoperative bronchitis, the convalescence was fairly smooth. The patient was discharged in about three weeks.

In March 1929, one year later, he had gained 30 lb. and had no gastric symptoms. He had some pain in his lower right abdomen so radiological studies were advised.

^{*} Read before the Los Angeles Surgical Society, October 10, 1930.

Dr. Davis found the gastroenterostomy to be freely patent with the majority of barium going through it. There was a deformity of the

during the nephrectomy and such a fistula occur, although a direct external fistula usually results following such an accident.



Fig. 1. Before operation showing interduodenal fistula.

Fig. 2. One year after operation showing functioning gastroenterostomy and narrowed duodenum.

duodenum which may have been produced by postoperative adhesions. The barium enema showed some angulation of the cecum probably caused by adhesions.

The patient was observed one month later and stated he was free from symptoms.

COMMENT

Cases of interduodenal fistula undoubtedly occasionally occur, although there have been no cases reported in the recent literature. A few cases of fistula between the duodenum and the gall bladder or into the stomach are on record.

The most likely explanation for the condition in this case is that an ulcer had perforated slowly from the first to the third portion of the duodenum producing the fistula.

It is possible that the posterior wall of the duodenum could have been injured

DISCUSSION

Dr. O. O. Witherbee: Various explanations concerning the process of development in this case might be advanced but when we remember the frequency with which the first portion of the duodenum is involved, compared with the third portion, it seems quite obvious that perforation must first have occurred at the higher level and the escaping contents, assisted by gravity, made their way downward, to be followed by ulceration and entrance into the bowel at this lower point.

It is well known that the intestine is prone, by a process of ulceration, to take into its lumen and eventually discharge foreign substances which have found their way into the abdominal cavity.

Some years ago a patient at the General Hospital discharged a mass of gauze as large as one's fist, that had been left in the abdominal cavity at a previous operation. This occurred without any evidence of peritonitis and with no special discomfort to the patient, excepting that occasioned by dilatation of the sphincter muscle.

HOUSTON VALVES

THEIR RÔLE AS A FACTOR IN RECTAL OBSTIPATION, PELVIC AND OTHER DYSFUNCTIONS*

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THE Houston valves were first described by John Houston¹ of Dublin. These valves are usually three in number, though four, five or more have been reported. They are arranged spirally, at different levels, about ½ in. apart, the end of one overlapping the beginning of the other. The first or lowermost is found about 3 in. above the anal border, the others from 1/4 to 3/4 in. apart, and the uppermost just below and being a landmark for the entrance to the rectosigmoidal junction. Each occupies about one-third of the circumference of the wall, normally is 1/4 to 1/2 in. in width from its attachment to the free border, and should present a good-sized opening between the free border of the valves.

Each valve is covered by mucous membrane, between which layers are found connective tissue, fat, muscle fibers, blood vessels, and some nerves.

Following Houston's description, Nélaton described a third sphincter muscle, with which Velpeau (1837), Gosselin, Kohlrausch (1854), Hyrtl (1857), Henle (1873), apparently agreed. O'Beirne (1833), Busche (1837), Bodenhamer (1870), absolutely denied the existence of these valves. Chadwich (1878) and Dr. Walter J. Otis (1887), American investigators, corroborate Houston's description and deny the third sphincter muscle theory.

The latter was probably the first to use atmospheric distention for the study of these valves, placing the patient in the knee-chest position and using retractors to hold the rectum open. This, Charles Martin, formerly of Columbus, Ohio, now of Washington, D.C., third president of the American Proctologic Society, described, using atmospheric inflation for

satisfactorily viewing these semilunar valves in the July and October numbers of Mathews' Medical Quarterly 1896. In 1899, before the American Medical Association, he read a paper entitled, "Phantom, Semi-lunar and Annular Strictures of the Rectum. Their Diagnosis and Radical Treatment under Direct Inspection."² And to Dr. Martin belongs the credit of reviving interest in the description of Houston's valves, but particularly is he entitled to describing and performing the first valvotomy. The existence of these valves were again vigorously denied by Bodenhamer.3 Dr. Joseph Mathews, deceased, the first president of the American Proctologic Society, very positively denies the existence of these valves.4 Otis, Martin, Pennington and Gant's observations agree with Houston in the main, and it is very probable that Nélaton, Hyrtl, Kohlrausch and Velpeau saw and described but one and the most prominent valve as the third sphincter.

Diagnosis: For viewing normal or diagnosing hypertrophied valves, one must have (a) the patient in the proper position, either the knee-chest or the Hayne's position, (b) a proper instrument, preferably a 10 in. proctoscope, and (c) a reflected light, or an electrically lighted proctoscope. Air insufflation in the Sims' position, does not permit of the proper viewing obtained by proctoscopic examination as in either of the inverted positions mentioned.

Function: The original theory that these valves were intended to support the fecal mass has been discarded, and their function to prevent the sudden deposit of the emptying sigmoid into the ampulla is accepted. Thus the physiological function may be-

come pathological when hypertrophy prevents the passage of the fecal mass through the rectum.

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Symptoms: The appended symptomatology was noted in over 200 cases examined, and 150 patients were operated on.

	Cases
Constipution	182
Bladder trouble	3
Neuritis or rheumatism	11
Pruritis	20
Dermatosis,	3
Backache	21
Feeling not empty	15
Nervousness	20
Colitis, blood, mucous	8
Hemorrhoids }	15
Protrusion, bleeding	45
Gas in bowels	30
Epilepsy .	2
Stomach, indigestion	30
Papillae, crypts	7
Fissure	13
Loss of weight	12
Faintness, malaise	•-
Prostate trouble	2
Age of patients—Years	
	Cases
5 to 10	3
10 to 25	22
25 to 35	105

-	Cases
5 to 10	3
10 to 25	22
25 to 35	105
45 to 55	40
55 to 65	16
65 to 75	4
Sex-	
Male	ენ
Female	127
Duration of symptoms—	
All their life .	40
I to 5 years	90
5 to 10 years	15
10 to 20 years	9

Difficulty in expelling enema, noted frequently. No constipation, recognized as such by patient, but two, three or more evacuations daily noted in 18 cases, in which proctoscope showed persistent retention.

Purplish, mottled, mucous membrane (hemachromatosis) above and Houston valves noted in 5 cases.

Pathology: The usual interpretation of hypertrophy, thickening, was much less frequently found than the thin wide valves, this increase in width obstructing the lumen or causing an overlapping of the free edges. No ulcers were seen, but varying degrees of inflammation of the mucosa

(proctitis) was observed in practically all cases. Recurrence of hemorrhoids, surgically removed, where hypertrophied valves with fecal retention were originally present, was encountered in 2 cases. The positions of the various valves were by no means constant. The positions in the same patient have been found changed from day to day, and a complete change of position has been observed during the course of examination. The positions observed follow—

•	Cases
Transverse .	29
No. 2 on right	53 60
2 on left	
ı on right	62
1 on left	46
3	25
4	I
5	1

Number of valves causing obstruction—

22 89 22

Treatment: Hypertrophy, in either thickness or width causing persistent fecal retention, was considered necessarily operative. A patient having hypertrophy without retention was not operated on or considered an operative case. Twenty-four cases were treated by massage digitally or massage with the proctoscope, and sphincters thoroughly dilated till a No. 4 Pratt's dilator entered easily. Local applications of saturated solution of magnesium sulphate, adrenalin or both, were applied locally. Five of these patients improved temporarily, i.e., the upper rectum was found empty on proctoscopic examination. In a few weeks or months the former condition of retention recurred. This condition is therefore considered permanently curable only by surgery.

Operation: Martin's original operation consisted of catching the valve with hooks, used through his 6 in. rectoscope, incising the valve to the muscle, suturing with a special long needle holder, and packing the incisions and rectum tightly with gauze to control hemorrhage, the gauze being removed in twenty-four hours.5 This operation was not attempted in this series.

Operations: In this series were performed in the Hayne's position, under novocaine 1 per cent perianal, 30 to 40 c.c., combined with sacral 1 per cent novocaine 30 c.c., or spinal anesthesia 100 mg. novocaine. Preoperative opiates were used in nervous patients. Originally the first operations consisted of excision of a u or v shaped sections, such openings as would be obtained by the use of the clips used by Gant and Pennington. These excisions were made with knife, scissors or diathermy bipolar current. Incisions were sutured except when diathermy used. In all operations the necessary exposure was obtained with a Sim's retractor, the valve grasped with an Allis forceps and brought to the anal opening. Hirschman's rubber ligature was used in 6 cases, or a section of the valve was excised parallel to the free border, sutured with a continuous Lembert catgut, leaving approximately a normal width valve. All of these methods were found defective. The u and v incisions filled from the bottom of the cuts, nearly to the top; rubber ligature method, same fault. The parallel excisions caused rigidity in the cut valve or valves and an altered topography causing obstruction in the remaining valve. The final operative technique evolved, producing uniformly good results, consists of grasping the valve at the point to be incised and drawing it out to the anal border. Two straight forceps are then applied v shaped, with the tips of the forceps close to the valve attachment at the rectal wall; the distance across the base of the inverted v, between the forceps being about 11/2 to 2 in. The Allis forceps are then removed, the valve held taut by the two straight forceps, the incision made with scissors from the point where the Allis forceps were applied to near the apex of the v. The excess of valve parallel to the forceps is trimmed away, leaving a small margin through which the No. 2 catgut chromic, interrupted sutures are placed; three or four on each side and one at the apex. Complete hemostasis is obtained; the forceps released, the valve springs back to

its original position. The same technique is used on the other involved valves. Operative time is ten minutes to each valve. The opening consists finally of two or more v shaped apertures with the bases opposed, and a valve of normal width remaining. Operative sites are mopped with 20 per cent mercurochrome, and the patient returned to bed without packing or dressings. Bowels opened on the third day, and the patient up and ready to leave the hospital on that day or the next. There is no postoperative pain, because the operative site is above the painful nerve supply.

The Postoperative Results: In all cases uncomplicated by gall bladder or appendix pathology were uniformly good. No catharsis or enema was required. One case in which a gastrointestinal series showed small and large intestinal stasis, patient sixty-three years old, was unimproved one year after operation. Fecal retention of ten to twenty-five years' duration in old people with atonic colons, responded slowly, but in none was catharsis or enema persistently necessary. Some form of mineral oil only was used in all cases for a varying length of time. Re-operated cases were those in which the original operative technique, clip or parallel excisions or rubber ligature were used.

Results obtained:

	Cases
Cured	54
Improved	71
Same after treatment	19
Died	2
Recurrence	4
Treated; not surgery	24
Observed; no treatment	52

The relatively large number improved over cured is due to a large number being Los Angeles General Hospital Clinic cases, and impossible to adequately follow-up.

Conclusions: In spite of adverse criticism regarding the operation or vigorous negation of their existence, it is felt that with the patient in the proper position and a properly lighted instrument used, no difficulty should be encountered in the diagnosis. The operation properly performed does

not alter the architecture of the rectum,⁶ except in a beneficial way. This being a drainage operation any pathology arising as a result of the rectum becoming a focus of infection, makes valvotomy a necessity.

Two or more evacuations daily usually denote an obstipation, rather than a normal condition, and as Gant has so properly said:

In persons suffering from chronic constipation it is unwise to venture an opinion as to the cause or causes of the trouble until the anus and the surrounding parts have been carefully inspected and palpated, a digital examination of the lower bowel has been made, the rectum and sigmoid have been thoroughly inspected through the proctoscope and sigmoidoscope.

Regarding the 2 cases of epilepsy, mentioned:

Case 1. Epileptic attacks irregular, about 3 or 4 a year from birth. Valvotomy Dec. 8, 1927. Attack occurred in Oct. 1928, following dietary indiscretion and consequent constipation. Patient's mother reported this as a very mild attack. No attacks since to date.

Case 11. Epileptic attacks about every six weeks; duration nine years, following constipation requiring catharsis or enema daily.

No attack since valvotomy July 9, 1929. Last attacks about June 25, 1929. This patient empties completely with one natural defecation daily. No cathartic or enema used since operation, but it is much too soon to expect result as to epilepsy.

One case, a female aged eighty-three years, died five days postoperative, in the Los Angeles General Hospital. No autopsy; no immediate cause of death discoverable. The second patient died of pneumonia, following a prostatectomy done under spinal anesthesia, two weeks after a valvotomy. If it is carefully done, there is no reason why the peritoneum should be opened; therefore no deaths should result. The technique of bringing the valves out to the anal opening makes valvotomy nearly as easy as a hemorrhoidectomy, which the motion picture should demonstrate.

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CONGENITAL ABSENCE OF THE APPENDIX VERMIFORMIS*

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\ONGENITAL absence of an appendix is a very rare anomaly. The first one who described this was Morgagni¹ in 1710. It was next reported by Hunter² in 1762 and by Haller³ in 1765. Eleven cases were reported in the nineteenth century and 23 in the twentieth century up to 1925, when Dorland4 wrote his excellent monograph on this rare anomaly. Since that time 7 other cases have been added; 3 were mentioned prior to the report of Dorland (one by Bloodgood⁵ in 1915, another by Swan⁶ from a personal communication from Guiteras in 1898, and the third by Marie in 1903) but were not included in his collection of cases; I case was described by Maurer,8 1 by Bradlev,9 and the sixth case was related to me by Dorland as having been seen by Sir W. Blair Bell of Liverpool, England, and I by Jacobs. 10 This makes a total of 44 cases and my cases are the forty-fifth and forty-sixth.

Of these cases, 9 were discovered at autopsy and 6 on the dissecting table; 4 are museum specimens, and the rest were found at operation. Some of these cases are not really true agenesis but are rather types of hypoplasia: In the case of Marshall and Edwards¹¹ there was an elevation of 2 mm. at the junction of the tenia coli and a depression on the inner side.

In the case of Bradley⁹ there was an elevation of 3 mm. These are therefore cases of hypoplasia. If we exclude these cases and also the ones where the diagnosis was made on the operating table in which the results might be questionable or where the appendix was not found but in which there were adhesions around the cecum, then the cases of actual agenesis of the appendix can be cut nearly to half. Indeed, probably it would be closer to the truth to say that only about 25 cases were undoubtedly true agenesis.

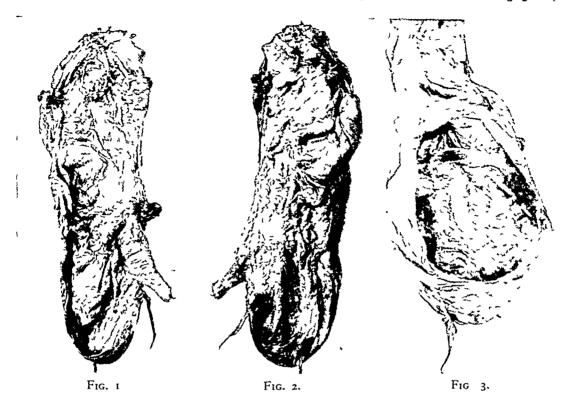
Our cases present some interesting features aside from their rarity. One specimen belongs to a male cadaver; the age of this male was about fifty years. The abdominal wall had no scars from previous operations: the abdominal cavity was glistening and there were no adhesions whatever. The terminal part of the ileum could not be brought outside the abdominal cavity. It was resting in a flattened position on the m. psoas major covered by the peritoneum. The peritoneum was smooth and shining. The cecum was smooth and shining and the lower part of it was moderately movable. The appendix could not be located. We followed the tenia which were arranged in the following way: The tenia coli anterior subdivided in two parts; one continued its course and the other turned in a semicircular manner to the medial anterior border of the cecum and joined the medial tenia which had a normal course. The posterior tenia sloped downwards and gave out one branch which turned medially and fused with the medial branch of the anterior tenia. Nothing was found at the place of junction of the tenia.

In order to ascertain whether we were dealing with a retrocecal appendix which did not take its origin right at the junction of the tenia, we made an incision through the peritoneum on the lateral side of the colon ascendens and cecum, exactly in the same manner as one employs for the mobilization of the duodenum by Kocher's method. After the peritoneum was incised, the finger was inserted behind the inner lip of the peritoneum and the cecum lifted. The posterior surface of the cecum and colon ascendens was turned anteriorly and was carefully palpated. No cord or anything resembling an appendix could be located. Indeed, we believe that in the

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operating room when one is unable to locate the appendix in the usual way, one should expose the posterior surface of the cecum by

The length of the cecum from the beginning of the lower lip of the ileocecal valve up to the dome was 315 in.; the



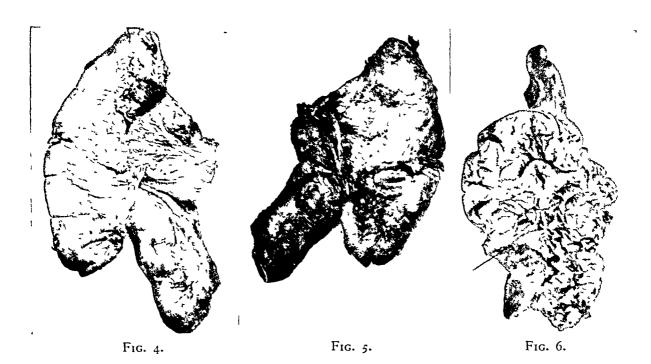
the manipulation mentioned here. Failing to find any traces of the appendix, we mobilized the terminal part of the ileum by incising the peritoneal fold just across the m. psoas major and by inserting the finger and lifting the ileum. Occasionally we found in cases of retrocecal appendix, that the terminal part of the ileum is bound down to the m. psoas major by a peritoneal fold. It might be of some use as a guide to a surgeon to know that the freely movable terminal part of the ileum does not necessarily mean that there is not a retrocecal appendix, but a terminal part of ileum bound down by peritoneal folds to the m. psoas does suggest a retrocecal appendix. When the ileum was raised, part of the peritoneum released from the psoas major was hanging from the ileum and a small piece from the cecum. It was thin and translucent, so that it was obvious that this band was not the appendix.

width was 21/2 in. The outer surface of the cecum was smooth and shining.

In several places strips of peritoneum from the visceral layer of the peritoneum twisted in a form of appendices could be seen; they were not, however, seen at the time of dissection and are seen now after the specimen has been for months in a preservative solution. As can be seen in Figure 1, there is a small appendix-like projection on the anterior surface of the cecum, just lateral to the ileocecal junction; another similar projection which looks like an appendix can be seen just below the ileocecal junction at the borderline of the medial and posterior surfaces of the cecum (see Fig. 2), and also a third projection is seen hanging down from the cecum (see Fig. 2). This appendix-like projection which starts below the ileocecal junction corresponds approximately to the place where normally the appendix takes its origin, because it is at the junction of the

three tenia coli. However, there was no such projection when the cecum was first exposed and it appeared only after

The second case was also found on the dissecting table. It was that of a female who died from tuberculosis.



the specimen had been lying in a preservative solution for a few months; it represents only strips of visceral peritoneum. To ascertain whether there were any traces of the opening where normally the cecum opens into the appendix, the cecum was opened and the following was found: The ileocecal valve was well developed, its upper lip more developed than the lower one which is a normal arrangement. On the inner surface of the cecum which corresponds to the point of junction of the tenia coli on the external surface, there is a smooth place, but about ½ cm. below is a

By trying to introduce a bristle, we saw that the depression ended blindly 1 mm. from the beginning. Looking from the outer side of the cecum at the pushing point of the bristle, one could see that it was pushing the wall of the cecum about .75 cm. from the root of the appendixformed projection. Therefore it is quite clear that this little dimple had no connection whatsoever with the projection mentioned here.

little depression (see Fig. 3).

At the place of junction of the three tenia coli there were no traces of appendix.

This second specimen is of great interest because it gives us some facts for critical analysis of some theories concerning the explanation of congenital absence of the appendix.

As is known, among different theories explaining absence of the appendix, the theory of Schridde12 is one of the most accepted. According to this theory, the appendicular portion of the primitive cecum fails to become arrested in its development as it normally should, but keeps pace in growing with the cecal portion proper and at maturity is indistinguishable as to caliber from a normal cecum. The reason why he gave such an explanation was that in his case the cecum belonged to a child fifteen months old; on the cecum were present six baustra instead of four. (As is known, the human cecum up to the age of four or five years has deep furrows which subdivide the wall of the cecum into four haustra; these haustra normally disappear at the age of four or

five years, due to intracecal pressure of the fecal material, and the cecal wall then becomes smooth.)

The fact that in his case there were six haustra instead of four and also the absence of the appendix, made him believe that these two additional haustra are the modified appendix and he explained, on the basis of his specimen, that normally the appendix is formed by the arresting of the growth of the lower two haustra; that at some period of the embryonic stage all six haustra are of the same size and width; later on the lower two haustra are arrested in their growth and form the appendix and the upper four continue to grow and form the cecum. Therefore, be advises: Whenever there is a congenital absence of the appendix count the number of baustra.

In order to corroborate his theory, one has only to deal with such cecum where the haustra are present, which occurs only in cases of children up to four or five years; in grown persons there are no haustra and dealing with an absence of appendix in a grown person, one can neither corroborate nor disprove this theory unless one comes across a case of absence of the appendix in a grown person with an infantile type of cecum which actually is present in our second specimen.

Four deep grooves cross the antero-

lateral wall of the cecum; the upper groove separates the cecum from the colon ascendens and the lower three form four haustra (see Figs. 4 and 5); the inner surface of the cecum is covered by numerous rugae; the ileocecal valve is clearly seen (see Fig. 6). In this specimen, of course, one could not look for a dimpleresembling the opening of a primitive appendix on account of the rugosity of the whole lumen. This specimen does not clear up and explain the causes of agenesis of appendix. However, it shows clearly that the theory of Schridde which is considered the most reliable cannot be corroborated by our analysis.

SUMMARY

1. Agenesis of the appendix is exceptionally rare; several cases described as agenesis are rather marked hypoplasia of the appendix.

2. To verify on the operating table the absence of the appendix in case it is not seen at the place of union of the three teniae, one should mobilize the cecum from the lateral side of the cecum and examine the posterior wall of the cecum.

3. Bound down to the m. psoas major the terminal part of the ileum is very suggestive of retrocecal appendix.

4. Our findings on specimen No. 2 do not corroborate the theory of Schridde.

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SIGMOID FLEXURE IN CONSTIPATION IN CHILDREN

PRELIMINARY REPORT*

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TN the usual discussion of constipation in children, diet and habit formation are stressed. Diet is emphasized in infancy because the high calcium caseinate content of the artificial formula tends to constipate; habit formation is the motif in the older child because the behavior problem is favored in our modern pediatric treatment. Should we question their infallibility, and investigate more carefully, - anatomical peculiarities of great interest may occasionally may be found. In a routine x-ray examination, the descending colon in many constipated children fills the lower abdomen, and the diagnosis of redundant colon, or enteroptosis is usually made. The former term is purely descriptive and of little pathological importance; the latter is usually associated with an asthenic habitus that is only rarely present before puberty. These criticisms, I feel, are warranted, for loose inaccurate terminology never stimulates further investigation.

This apparently excessive large bowel may be identified pathologically and radiologically as the sigmoid flexure, and it is the sigmoid flexure I will discuss; the etiology of its enlargement and the pathological sequelae that often demand surgical intervention.

The normal adult sigmoid flexure is usually s-shaped and small. It has been recognized since the seventeenth century that an apparently elongated and multi-looped sigmoid was normal^{1,2,3} in infancy,⁴⁻⁷ but it remained for the memorable discussion at the French Academy of Medicine, in 1859, to crystallize the subject.

At that time it was suggested that in congenital rectal atresia, the artificial anus be made on the right side instead of the left. Huguier found that the sigmoid

flexure was long and tortuous and was directed transversely in the pelvis from left to right, reaching ordinarily to the

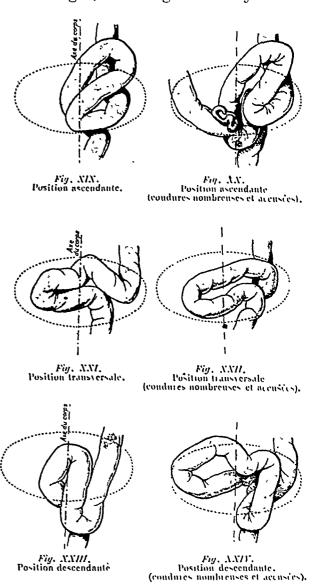


Fig. 1.

right iliac fossa. His work was subsequently altered by Bourcart, who described three types of sigmoid looping; the ascending, transverse and descending (Fig. 1).

McMurrich,⁸ in his manual on embryology, quoting Treves, explains the in-

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fantile peculiarities of the sigmoid and their origin in the following manner.

The lower portion of the large intestine is thrown into a loop which extends transversely across the lower part of the abdominal cavity, and represents the sigmoid flexure of the colon. At the time of birth this portion of the large intestine is relatively much longer than in the adult amounting to nearly half the length of the colon, but after the fourth postnatal month, a re-adjustment of the parts of the colon occurs, the sigmoid flexure becoming shorter and the rest of the colon proportionately longer, whereby the cecum is pushed downward until it lies in the right iliac fossa, the ascending colon being thus established.

This physiologically elongated flexure with its immaturely developed musculature lies cramped and coiled in the small pelvis of the infant. The pelvis is smaller in the male than in the female and explains the greater frequency9 of constipation and pathological flexures in the male child. When we recognize the presence of both factors, the marked infantile looping of the sigmoid and the smallness of the pelvis, it is easily understandable why accidents occur. The elongated flexure in late prenatal or early postnatal growth when distended with meconium may kink or compress an intestinal portion with resulting acute obstruction.

We see megacolons for this reason in the fetus and often in the newborn. The breast fed child, when its food is sufficient in quantity, usually has normal intestinal behavior. Nature has provided, in breast milk, a food which fulfills most accurately the metabolic requirements of infancy; it is liquid in composition and being most easily digested, absorbed and utilized, promotes normal intestinal function in the physiologically looped lower bowel. 11 This fact implies the compatibility of the breast milk feces and the adequacy of peristaltic function in propelling the intestinal material without disturbance. During development, the sigmoid flexure assumes the configuration of the adult s-shaped sigmoid.

The persistence of the infantile macrosigmoid beyond this period is no longer physiological, and retards the evacuation of artificial foods. With the institution of artificial and mixed feeding, foods more difficult to digest are retained in the intestinal tract a longer period, to insure the greatest possible utilization. With the abundant refuse and casein of the new diet, a greater bulk of fecal material is passed through the elongated flexure. Habitual constipation of this weaning period inaugurates or increases the vicious circle that assures the persistence of the macrosigmoid. 14,19

When the constipation is permitted to continue, the vicious circle formed increases the tortuous infantile flexure and, therefore, the associated constipation, and the smooth musculature of the sigmoid flexure is forced to progressively increasing exertion. According to Bloch, this musculature is not maturely developed and its reserve is, hence, not unlimited. 15,16 To recapitulate, the fecal stasis, at first inconstant and brief, becomes more or less chronic.17 Gaseous distention follows. The sigmoid musculature eventually becomes insufficient and is unable to propel the increasingly constipated fecal material through its elongated tortuous channel. 18 Cathartics and enemas increase this insufficiency. The constant pressure of contained gas aids in forcing feces onward, yet exerts a distending influence towards its weakened walls, and habitual constipation results. Certain accessory factors may exert their influence, as the muscular atony in rickets, myxedema and severe diarrhea.

Before discussing the more serious sequelae of the elongated, or macrosigmoid, the question arises whether it represents a physiological need. During infancy, the most economic period in life, food is most accurately adapted to metabolic requirements and must be completely utilized, to prevent, in so immature an organism, general or intestinal disturbances, which may be fatal. Bloch has found glands¹⁹ of Lieberkühn, with Paneth cells, in the

elongated colon of infancy, and Max Rubner²⁰ attributes the better utilization of cow's milk by the infant as compared to the adult to the presence of additional secretory glands in the elongated colon. Babak,²¹ following the work of William Roux on functional adaptation, investigated the influence of various types of food upon intestinal length in the omnivorous tadpole. The more artificial the food and the more difficult its digestibility, the greater was the elongation of the colon. When we bring this work in functional physiological morphological relationship to food, we may suggest that foods abounding in cellulose and hence with difficulty digested aroused and caused a relative enlargement of the intestinal surface. With the feeding of abundant cellulose enclosed foodstuffs during the weaning period, the persistence of the macrosigmoid may be visualized as a necessary accommodation to insure adequate utilization.

The conception described is purely mechanical. Whatever rôle the vegetative or endocrine systems assume, has not yet been determined, and must be part of our future problem.

It may be advisable to state here that in my cases of macrosigmoid, glandular treatment was ineffective, and only a purely mechanical therapy brought about complete restoration of normal function.

Elizabeth F., aged six, was habitually constipated since birth. Spontaneous bowel movements never occurred. Drastic cathartics and enemas were required to effect daily defecation. The child, under constant medical care was diagnosed a behavior problem, and, for a period of years, was so treated without result.

When examined, she was 4634 in. tall and weighed 41 lb. Physical examination was otherwise negative. Proctoscopic examination likewise revealed no pathology. A 2000 calorie diet, high refuse, with 12 per cent protein, 23 per cent fats and 65 per cent carbohydrate and one tablespoon of olive oil by mouth, was given, without results. Vitamine B was later added in the form of malt extract, and was likewise ineffective.

A 2000 calorie diet, low in refuse, and one tablespoon olive oil by mouth, was followed by

almost immediate result. During six months, on this regimen, Elizabeth had two spontaneous bowel movements daily. Her weight has in-



Fig. 2.

creased to normal from 41 lb. to 50½ lb. Nausea and anorexia have never returned.

I am presenting only I case, because of limitation of time. The radiologist's diagnosis was:

Stases caused by marked redundant descending colon and the trap-like effect, both hepatic and splenic flexures (Fig. 2).

A more accurate analysis suggests many important inferences. Clinically habitual constipation, nausea, anorexia, malnutrition have been present since birth. All are attributable to the intestinal pathology. Only drastic cathartics and enemas made defecation possible. The enormous elongation of the sigmoid flexure, muscularly insufficient, represents a functional, relative stenosis. Nausea and anorexia are not due as Kerley22 suggested in his article on Enteroptosis in children, to retention of gastric contents, but to reverse peristalsis aroused by the abnormal behavior of the intestines. The apparent stasis and traplike effect at both flexures and the fortyeight hour retention of barium in the transverse colon were also functional, and have since disappeared. With intestinal rest, all symptoms disappeared and normal intestinal behavior, after these years of muscular insufficiency, was resumed. The

musculature of the sigmoid flexure became sufficient.

Elizabeth, in her treatment, was placed



Fig. 3.

upon a high refuse diet, then one rich in vitamine B. Both were inadequate, and gave no relief. When refuse, cellulose, was subsequently removed from her diet, and oil was administered by mouth, response occurred almost immediately.

Glandular therapy given in the beginning was ineffective.

With intestinal rest, the insufficiency of the sigmoid flexure musculature became sufficient. Subsequent radiological studies have been demonstrated, showing the partial return of the markedly elongated, tortuous, insufficient sigmoid to its normal size and contour (Fig. 3).

We may consequently infer that, just as removal of refuse, reduction of gas formation and stagnation have been followed by a reduction in size of the macrosigmoid and have reestablished normal physiology, so the reverse may likely be true: that the elongation of the sigmoid, and its muscular insufficiency followed habitual constipation and the intake and retention of excessive indigestible material.

In the case presented, there is a definite clinical pathology due to abnormal behavior of the intestinal tract. We can visualize how a more pronounced muscular insufficiency can lead to a muscular decomposition, with resulting megacolon or volvulus.

Stage of Decomposition: The child with a macrosigmoid, habitually constipated, usually avoids the dangerous intestinal complications which may threaten life. When the musculature of the elongated sigmoid becomes insufficient and the peristalsis is no longer able to cause evacuations, hypertrophy muscular occurs. decomposition becomes complete, the sigmoid, unable to empty itself, commences to dilate. Gas formation and muscular hypertrophy are temporarily able to propel feces into the rectum. With decomposition, however, the flexure becomes filled and either kinks at the rectal sigmoid junction, or forms a valve. These constitute a stenosis and the true picture of megacolon results. During any pre-megacolon stage, treatment and cure are made possible by one procedure: rest. Rest in megacolon is attained through the insertion of rectal tube facilitating a constant drainage of feces and gas; the ingestion of a diet low in refuse, and oil by mouth; or when necessary a colostomy may be done (Kerley).

Kinking occurs at the place of transition from flexure to rectum for several reasons: the presence²³ of a natural narrowing and the lack of fixation of the mesentery at this place so that the upper portion is mobile while the lower is not.

Roser has made a diagram and described²⁴ a type of stenosis at the rectal sigmoid junction with valve formation resulting from loop formation and fecal stasis. On rectal examination, the small or index finger when admitted, apparently enters a large sac-like cavity: despite the patency to the finger, the gruel-like contents are not satisfactorily evacuated. The colon is markedly distended and the abdomen extremely large. With the introduction of a rectal tube, the intestinal contents are evacuated, and the valvular

mechanism disappears but the stenosis recurs, when the intestinal portion above the functional structure is permitted to overfill.

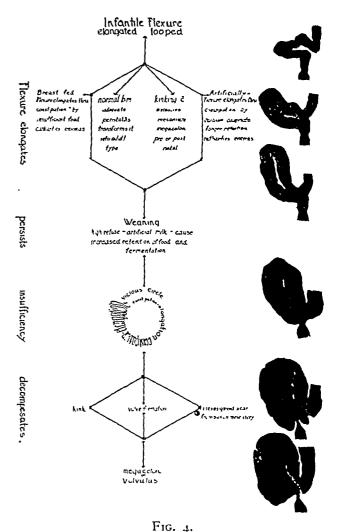
The elongated sigmoid flexure and train of events, just described, lead to habitual constipation, gas formation, distention and finally decompensation of the intestinal musculature. At the rectosigmoid junction, the flexure distends against the immobile rectum, compressing it, sometimes causing a pre-megasigmoid. Such a stenosis is relieved only after long drainage, permitting the tone of the intestinal musculature to return to normal and subsequent dietary and medical care prerecurrence the of constipation.

Although volvulus of the sigmoid does not occur during childhood, its precursor, the macrosigmoid, is definitely a part of our subject. The manner in which the macrosigmoid predisposes to volvulus is evident; time will not permit its discussion (Fig. 4).

SUMMARY

- 1. The sigmoid flexure of the infant is usually elongated and looped. Its mesosigmoid is attached relatively high on the vertebral column and is freely movable.
- 2. During infancy it represents a physiological condition in which breast milk and peristaltic adequacy result in normal bowel movements and the eventual assumption of normal adult sigmoid configuration.
- 3. With errors in artificial feeding, and the feeding of excessive food material which is digested with difficulty, the infantile elongated and looped sigmoid (marcosigmoid) persists, instead of assuming the normal adult contour and size.
- 4. The persistence of the elongated and looped sigmoid flexure beyond infancy represents a pathological situation which is an etiological factor in the causation of chronic constipation, megacolon and volvulus. In the clinical histories of these conditions, the constipation dates always from birth or from the time of weaning.

5. The abnormal position of the infantile, macrosigmoid in the adult sometimes leads to carcinoma of the sigmoid and may inter-



fere with the correct diagnosis of exudates or tumors in the right iliac region, should it extend thereto.

- 6. This conception stimulates the early recognition of the pre-Hirschsprung and pre-volvulous stages. Through proper therapy, such disastrous entities may sometimes be prophylactically treated.
- 7. The treatment is essentially one of rest. The feeding of foods easily digested, of as little bulk as possible is called for, for cellulose and refuse cause fecal stagnation, gas formation and intestinal distension. Removal of refuse makes intestinal rest possible. The secondary injuries to the abdominal wall of inflammatory nature tend to subside with a low refuse diet and

the addition of oil by mouth. Alvarez has emphasized the rapidity with which the distended colonic musculature fatigues and assumes a refactory condition.

Its tone returns. The decompensated intestinal musculature responds to rest as does the musculature of the heart, and

without intestinal rest, healing cannot occur.

8. By these therapeutic means, the persistent infantile elongated flexure is readily responsive and in time, according to our investigations, will assume the normal shape and size in the child.

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PRESENT CONCEPTION AND TREATMENT OF SHOCK*

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PATERSON, N. J., AND WOODSIDE, L. I.

In spite of the vast amount of experimental work and clinical data available, the subject of shock, both medical and surgical, is still little understood. There have been assumed many and varied explanations of the condition, some of which are still accepted as at least in part correct. Others have been discarded entirely.

The mechanism of surgical shock has been studied recently by capable men, among them being Cannon, Henderson, and Crile. A number of facts has been definitely established.1 Crile believed that shock was caused by exhaustion of the vasomotor center by excessive stimulation of the nerve fibers in injured parts of the body. However, later experiments proved that in shocked animals the vasomotor center remains active and that local vasomotor relaxation follows section of the nerve trunk. Later1 Henderson demonstrated that in the early stages of shock, the blood pressure remained unchanged, although there was a diminished flow of blood from the heart, which demonstrated that for a time at least the vasoconstricting mechanism is intact.

These experiments were later confirmed by artificially producing shock. It was observed that in the cat shock could be induced by traumatizing the flexor group of muscles of the thigh by crushing with pincers (not by hammering).

Prior to producing injury to the muscle, the cord in the lumbar region was severed. Yet when the muscle had been crushed with pincers, shock resulted. The experiment was carried still further by cutting the nerves to the limb at the point of emergence from the pelvis. Furthermore, the shock was not produced when the

nerves were allowed to remain intact with the blood vessels tied, i.e., the blood supply to the muscles which were injured was destroyed. This experiment clearly proved that some substance, which was given off by the injured muscle itself (eighteen to twenty minutes after injury) was the cause of the drop in blood pressure. This shock occurred only after the blood was permitted to flow into and out of the damaged region. This clever experiment was performed by Cannon² of the British Shock Committee.

Dale and Laidlow³ studied experimental shock by injecting histamine, which in the cat family causes typical shock-like failure of the circulation. The picture resulting from the injection was similar in every respect to the shock which resulted from the local injury to a muscle or group of muscles, when injured by crushing. The studies of these men were rather complete. Blood pressure readings, blood chemistry, hemoglobin, cell counts, and plasma volumes were recorded in both the arterial and the venous blood; and finally there was examination of the organs. The vena cava in the thorax was found to be flaccid and half empty. The condition of the portal vein was the same. The arteries, both large and small, also contained little blood and were found to be constricted rather than dilated. This latter finding appeared to be paradoxical in the face of a low blood pressure. The amount of blood in the liver and in the spleen was markedly decreased.

Since the blood was not to be found in the larger vessels or in the organs in which one would expect to find it, it was necessary to seek elsewhere for the missing volume. The small volume of blood which was found remaining in the vessels was concentrated,

^{*} From the Surgical Service of Dr. T. A. Clay, Paterson General Hospital. Submitted for publication November 15, 1930.

i.e., there was an increase in the proportion of solid elements. The loss in volume was chiefly, then, due to a loss in the plasma. By exclusion, this blood was located in the capillaries. These findings seemed to point to the fact that capillary tone must be lost throughout the body.

And thus we have in shock a picture of the blood rapidly leaving the veins, causing the venous pressure to fall. The heart consequently does not fill in diastole; its output decreases and there is a fall in blood pressure. The arterial constriction is apparently an attempt to compensite for the fall in blood pressure. In reality it causes a greater stagnation in the capillaries. This cycle can only be explained by a loss in capillary tone.

The British Shock Committee's performed further complete studies which confirmed these findings. To determine blood volume, they injected vital red stain in the normal animal and in the animal in shock. By the use of the Duboseq colorimeter, plasma volumes were then estimated. They thus definitely showed the loss in blood volume in shock where no actual hemorrhage had taken place.

Through these experiments certain conclusions are to be drawn. The marked hypotension in surgical shock is not due mainly to a loss of arterial tone or to failure on the part of the heart. It is apparently due to a lessened flow of blood to the right auricle, caused mainly by an accumulation of blood in the capillaries and a loss of plasma from the greater vascular tree. This accumulation might be brought about by a direct injury to the part (as in surgical operation) or it might be caused by vascular poisons absorbed from damaged tissues. (A case of shock due to snake bite poisoning is reported by Atchley.)

Clinically these cases show a low or falling arterial pressure, a rapid thready pulse, a subnormal temperature, cold skin, moist with perspiration, a pallid or grayish or slightly evanotic appearance.

This condition is met with frequently in the active hospital; and as a rule,

"routine treatment" is ordered. Usually this consists in application of heat, sedatives for pain and restlessness, and fluids; and in severe case, elevation of the foot of the bed. But it is chiefly with the restoration of a deheient circulation that we should concern ourselves. Stimulants have been discarded as ineffectual. Cardiac stimulation in the absence of cardiac disease is not indicated. Adrenalin is contraindicated because it causes further constriction of the arterial vessels and not an increased nutritive flow through the capillaries. This restoration of volume can only be obtained by increasing the volume flow.

Pluids may be given by mouth or by rectum. But these routes are often either impossible or inadequate. Fluids given subcutaneously are absorbed too slowly by the damaged capillaries, especially if the shock is at all severe. Intravenous injection is really the only method by which the volume of circulating fluid may be increased quickly and surely.

Blood transfusion is undoubtedly the best way of restoring volume; but this has the disadvantages of not being available or of the supply's not being adequate, not to speak of the time element and technical procedure necessary. Many substitutes for whole blood have been used. Among those in use are acacia, hypertonic glucose, normal saline, and combinations of two or more of these. Theoretically, acacia has the proper viscosity and the osmotic pressure of the blood colloids and it is chemically inert and harmless. Thus it retards the passage of the water from the vessels. However, there are objections to the use of acacia, chief among these being reports of anaphylaxis.

Hypertonic glucose increases the blood volume and extracts fluids from the tissues into the vessels, and at the same time supplies carbohydrates. But since Cannon showed that the blood sugar is above normal in shock and that there is no decrease in the alkali reserve, I see no indication for the employment of this solution. There are no acetone bodies in the urine.

The loss of plasma volume in shock differs, for example, from the loss found in the diarrheas of infancy in that it is not accompanied by acidosis. Podgett and Orr, in treating experimental shock with glucose solutions, found almost identical results whether given with or without insulin. It seems most likely that the beneficial effects of the glucose solution are due mainly to the water introduced with the glucose.

Experience till recently with the use of normal saline solution has not been entirely satisfactory. The explanation of its failure was thought to be due to the fact that since it is a crystalloid solution, it is so readily permeable that it does not maintain the blood pressure increase that follows immediately on the injection. Recently, however, the work of McFee and Balbridge⁶ with saline solutions and Warthen's with dextrose have stimulated the use of intravenous infusions in larger quantities. It seems from the work they report that the value of intravenous infusion was not fully appreciated because the quantity of fluid used was insufficient. In the surgical department of the Johns Hopkins Hospital from 300 to 1000 c.c. of 5 per cent dextrose in normal saline is given by needle, three way stopcock, syringe method, when only a small amount of intravenous fluid is needed to overcome shock. When, however, the condition of the patient necessitating the initial administration is likely to persist, or when the patient has veins unsuitable for repeated punctures, a cannula is inserted into the incised vein and continuous flow is maintained7 (Hendon method).

In the few cases which we have treated with large quantities of intravenous infusion, the results have been gratifying. One case of intestinal obstruction received 3300 c.c. of saline in twenty-four hours, following resection of 14 in. of gut. In this case lacrimation appeared and the infusion was stopped. Since the blood chlorides are rapidly lost in intestinal obstruction with the vomiting, it was thought that in this

case the infusion was the decisive factor in the patient's recovery. Another patient having appendicitis with peritonitis whose



Fig. 1.

systolic pressure was 100 after incision and drainage under nitrous oxide anesthesia, was given a total of 4000 c.c. of normal saline intravenously in two doses within forty-eight hours postoperative. In this case the opinion prevailed that the infusion was the therapy that turned the tide in the patient's condition.

The amount of fluid used varies in many clinics. But water intoxication should not take place if the blood pressure is carefully watched and if the injection is discontinued when the patient begins to perspire or has lacrimation. I have given as high as 1700 c.c. in one hour to a patient in shock following gastroenterostomy for malignant obstruction. There was no ill effect. In this

case the systolic pressure was 105 on leaving the table and following the infusion it rose to 150. This patient had a moist tongue and lips for twenty-four hours following the procedure and of course no fluid was required by mouth.

Some of the patients had chills immediately following the infusion of the saline. Matas's feels that a chill following this therapy is an indication of resistance and vitality, because it was absent in his more debilitated subjects. He found that a larger percentage of his cases having reactions recover. This then may be of some prognostic value.

I have found it difficult to give large quantities of fluid intravenously with the usual gravity method. Among other objections, this gravity method is too slow. Because of these inconveniences, the Scannell apparatus for transfusion was used. However, it is cumbersome and somewhat complicated. The apparatus described below is an outgrowth of these difficulties.

A glass T-tube is inserted between the gravity tube and the needle, which needle should preferably be of the type with a

shield to rest on the patient's arm. To the perpendicular of the T-tube, by means of rubber tubing, a 50 c.c. Luer syringe is attached. The other equipment required is the ordinary infusion bottle for transfusion and an artery clamp.

The artery clamp is placed on the tubing just above the T-tube. When the clamp is removed, the fluid flows into the vein and into the syringe displacing the plunger. When the syringe is full, the clamp is reapplied; gentle pressure is exerted on the syringe, thus forcing the fluid into the vein. The clamp is removed and the procedure repeated until sufficient fluid has been given. In my cases 500 c.c. are given in a period of from thirty to forty minutes. In no case have there been any ill effects from giving the fluid at this rate.

The advantages of the apparatus lie in its simplicity; in the fact that the treatment can be given at the bedside; that the patient is but slightly disturbed; that a large volume of fluid may be given in a minimum of time; and that the flow into the vein is continuous. Thus there is no clotting in the needle.

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OPERATIVE TREATMENT FOR ADRENAL CORTICAL OBESITY*

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T is well recognized that one type of obesity frequently encountered is due to an endocrine imbalance. This imbalance may be precipitated by an altered activity of one, or any combination, of several glands which include the gonads, the thyroid, the pituitary and the adrenals. The obesity occasioned by a disturbance in the adrenals is perhaps less often recognized and understood than that of any other group. The eunuchoid, the hypothyroid, and the hypopituitary types are well known and readily diagnosed. It is our impression that the type due to adrenal disturbance also presents a very definite syndrome. The obesity of adrenal origin is always associated with a disturbance in the cortex. This disturbance is based on either a diffuse cortical hyperplasia or a cortical neoplasm. These pathological changes produce three different syndromes depending upon the age of the individual at the time of their development. If the lesion occurs during intrauterine life, there is a disturbance in sexual development causing hermaphroditism, in a large number of cases. When the pathological changes begin during early infancy, precocious sexual development results. This type is by far more common in the female, and is very often associated with obesity, excepting when the adrenal cortex is the seat of malignant neoplasm. The third type develops during adult life and is accompanied by obesity, changes in the secondary sexual characteristics toward the male line, such as hirsutism, thickening of the skin and changes in the voice. Amenorrhea of variable duration is a concomitant feature. The obesity may reach extraordinary degrees. The fat is generally distributed with an accentuated deposition in the hips, buttocks and abdomen, breasts, thighs and arms. The forearms and

legs are frequently singularly free from fat accumulation. The hands and feet are rather small. Related to this third group is the obesity in old women with the growth of hair in the face. Examination of the adrenals in the latter cases invariably reveals the presence of one or several cortical adenomas.

It has been known for some time that the adrenal cortex influences fat metabolism. This relationship has been experimentally demonstrated by the fixation of blood fats in the tissues after injection of interrenin, the specific principle of the adrenal cortex isolated by one of us1,2. These observations have been confirmed recently by Kohno,3 Schmitz and Milbradt, 4 Reiss⁵ and others. In the light of these facts some older experiments gain interest. Adler, McKinlay and Fischer,7 Castaldi,8 Fieschi9 and others obtained a considerable increase in body weight if they fed their animals dried adrenal cortex. McKinlay and Fischer also observed a stimulation in the development of the testicles while Adler who fed dried cortical adenoma to tadpoles obtained premature male sexual development together with rapid growth. Very important are also the observations of Iscovesco¹⁰ and Fieschi who both saw a rapid growth of hair in rabbits after shaving if they were fed cortical substance.

The relationship of cortical hormone to fat metabolism and the results of the feeding experiments quoted here seem to indicate that a hyperactivity of adrenal cortex may be able to produce pathological fat deposition and may also account for pathological growth of hair. The logical conclusion therefore is that obesity and hirsutism accompanying adrenal cortical hyperplasia or tumor are an expression of cortical hyperfunction. On this basis it is

^{*} From the Surgical and Pathological Services of the Crown Heights Hospital.

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rational to propose similar surgical therapy to that advocated for other hyperfunctioning glands, as for example the thyroid.



Fig. 1. Low power view of whole cross-section of adrenal gland. Note two distinct strata of cortex and narrow layer of medullary tissue in center.

This line of thought was put to the test in the following case.

K. B. female, twenty-three years old, complaining of extreme obesity was admitted to the Crown Heights Hospital on Sept. 27, 1929. She is one of seven children, all others of whom are perfectly well. There is no history of metabolic disturbance in the family. She began menstruating at the age of thirteen. She was very irregular, the intervals varying from two weeks to three months. The flow lasted seven days, was scanty, and without pain. Her appetite was voracious, she was not constipated, had no nausea, belching or polydipsia. She had a marked frequency of urination and nocturia, often voiding as many as fifteen times a night. At twelve she had influenza, at which time she weighed 100 lb. During convalescence after "tonic" treatment she began to gain weight, so that within a year she gained 75 lb. She continued to gain progressively until on admission (eleven years later) she weighed 335

lb. One hundred and twenty-five pounds of that weight were gained in the past year. Her voice became deep rough and masculine in char-

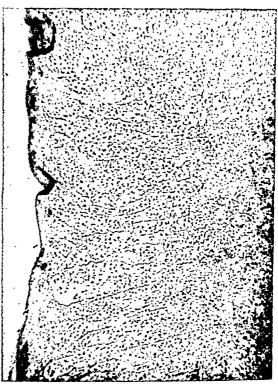


Fig. 2. Cortex of adrenal. Outer stratum with extensive lipoidosis. Intermediary stratum with darker cells containing but little lipoid. Low power.

acter. Hair began to appear on her chest, face, abdomen, forearms and legs.

On examination she presented the following findings: A young woman extremely obese, with fat distribution particularly in the region of her abdomen, hips, arms and thighs. There was a marked growth of hair on her face, extremities, breasts and a masculine distribution of pubic hair extending up to the umbilicus. Her voice was deep and her skin thick.

Laboratory Findings: Urine, specific gravity 1018, no albumin, no sugar, microscopic negative. Blood count, hemoglobin 85 per cent, red blood corpuscles 5,160,000, white blood corpuscle 8,500, polynuclears 78 per cent. Blood pressure 105/62, lymphocytes 21 per cent, monocytes 1 per cent. X-ray, skull showed a normal sella turcica. Wassermann test negative. Kahn-test negative. Basal metal rale, plus 8 per cent. Blood chemistry, sugar 120, creatinine 1.1, urea 10.0.

A perirenal insufflation of both kidneys was performed with the purpose of visualizing the adrenals by means of the x-ray, but the

trophied, probably three times the size of a normal gland. No adenomas were visible, the surface was regular and smooth. The wound

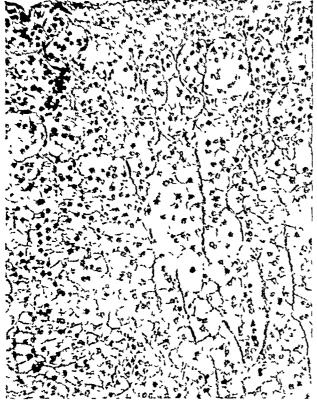


Fig. 3. External portion of cortex with extensive lipoids. High power.

extreme obesity prevented obtaining a conclusive result.

Diagnosis: On the basis of these findings the diagnosis of hyperfunction of the adrenal cortex was made. The differential pathological diagnosis between cortical adenoma and diffuse bilateral hyperplasia, however, was merely speculative and had to wait surgical inspection.

Operation and Findings: The incision extended from the tip of the last right 1 ib to the anterior superior spine, down to the perirenal fat. This was stripped from the kidney which was then drawn into the lower angle of the wound, covered by a lap sponge and held there by a retractor. The hand was then introduced high into the vault of the exposed area and the fingers found the adrenal gland in the fat. It was easily recognized by its firmer consistency and slightly granular surface. It might be noted here that if any difficulty is experienced in exposing it to view, it is easily obviated by resection of the last rib. A ring clamp placed on the organ helps expose it to view. The right adrenal so exposed was very much hyper-

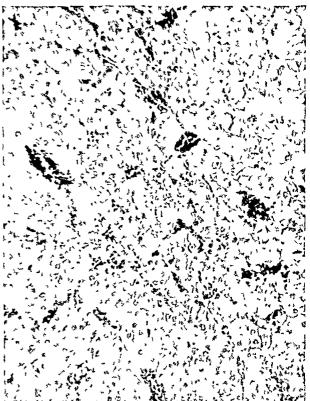


Fig. 4. Central stratum of cortex and pheochrome tissue. Cortical cells darker and granular. Many capillaries filled with red blood cells. High power.

was closed in layers and a similar incision made on the left side so that the left adrenal might be exposed. This was even slightly larger than the right, had a smooth surface, showed no adenomatous growth and was therefore resected after the blood vessels entering it were ligated. A cigarette drain was placed in the vault, the kidney was reposited and the wound was also sutured in layers. The drain was removed in forty eight hours and the wound treated like that of a nephrectomy or pyelotomy operation. Primary union was obtained on the eighth day, the sutures were then removed and the patient proceeded to convalesce uninterruptedly.

Pathological Findings: The measurements of the gland were as follows:

Length 62 mm.
Width . 39 mm.
Thickness. 11 mm.
Weight. 16 grams

The gland is embedded in soft yellow fat tissue. It takes careful preparation to separate

this from the surface of the gland. The gland itself is light yellow in color and fairly soft to touch. Its substance is somewhat friable as a result of which the gland was slightly injured on removal. Sections made perpendicularly to the longest diameter of the gland show a rather broad cortex which divides clearly into two strata. The outer layer which is about 3 mm. in width is of bright yellow color. The other stratum is of a darker brownish color. Compared to the bulk of the cortical tissue there is but scanty medullary tissue present (Fig. 1). Only at the lower pole and corresponding to the hilum of the gland are more substantial amounts of medullary tissue found.

Microscopical examination shows that the glomerular layer of the cortex has practically disappeared inasmuch as the fasciculata reaches up to the capsule (Fig. 2). The cells of this layer are very large and look like plant cells (Fig. 3). The vacuolar character of these cells ceases almost abruptly, for the polyhedral cells of the deeper stratum are well stained and their cytoplasm is finely granular (Fig. 4). These cells stain quite well with eosin but they are slightly basophilic. The solid mass of these cortical cells shows scattered islands of vacuolar cells similar to those of the outer stratum. The central portion of the cortical tissue surrounding the larger vessels or bordering on the medullary tissue shows a great deal of brown, finely granular pigment.

The cells of the medullary tissue are large, polyhedral, with abundant chromaffine granulation. They are imbedded in a fine reticulum and separated by a multitude of capillaries most of which seem to be collapsed. The larger veins of the gland particularly those close to the hilum show well developed musculature.

Postoperative Course: This was uneventful, the patient leaving the hospital with both wounds healed fourteen days after operation. During her stay the highest temperature was 100°F. on the second day postoperative. The blood pressure which two days after operation was 105/62 rose so that on the sixth day it was 146/68. On discharge it was 110/60.

The first month she lost 25 lb. and thereafter 15 lb. a month so that on October 8, 1930, she weighed 190 lb., having lost a total of 145 lb. This loss is even more significant because before she came under our observation she had received 12 grains of thyroid extract daily over

a period of nine months with a total loss of weight of only 17 lb., following which period she gained 125 lb. in the course of a year. At the time she took thyroid treatment her basal metabolic rate had risen to plus 38 per cent. For the first two months after her operation she menstruated every two weeks and since then her menstrual periods have been regular every month for a period of five days.

Six weeks after operation the patient reported the observation that the hair on her head had lost its normal curl and became quite straight.

Her nocturia has been reduced to twice a night. Her appetite is normal. It is to be stressed that since operation, she has received no medication, nor has she been subjected to any dietary restrictions.

Discussion: The striking results obtained in this case by unilateral adrenalectomy vividly demonstrate the value of reducing the mass of hyperactive cortex in the treatment of this type of obesity. The rationale is similar to that of subtotal thyroidectomy for hyperthyroidism.

The success of this operation induced us to try the same in another case which we believed might have a similar pathological basis, in spite of certain clinical differences, such as fat forearms and legs; broad, heavier bones in the hands and feet, heavy bones in the face with marked molar prominences, normal menstrual history. Surgical exploration however, revealed adrenals of not more than ordinary size. Histological examination of one of the glands, removed at operation, failed to demonstrate changes of the cortex. The postoperative observation of this patient did not show any noteworthy depletion of the fat deposits.

This observation emphasized the importance of an accurate diagnosis of adrenal cortical hyperfunction before the removal of an adrenal for the cure of obesity, nor should an adrenal gland be removed before the other gland had been inspected. This is particularly important in the cases where the adrenal lesion consists of a unilateral adenoma, in which the other gland might appear practically normal. In a case of bilateral hyperplasia like the one reported here, the choice remains with the surgeon who probably will find it easier to remove the left gland.

Conclusion: A successful operative treatment has been described for the cure of obesity due to adrenal cortical hyperfunction.

[For References see p. 317.]

A CASE OF

SPONTANEOUS HEMOPNEUMOTHORAX

(WITH SOME SIMULATION OF AN ACUTE SURGICAL ABDOMINAL CONDITION)*
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R ECENTLY Hurxthal¹ reported a case of spontaneous hemopneum-othorax in a young male who pre-

interest and importance because the symptomatology at first suggested the need of surgical intervention in a case where

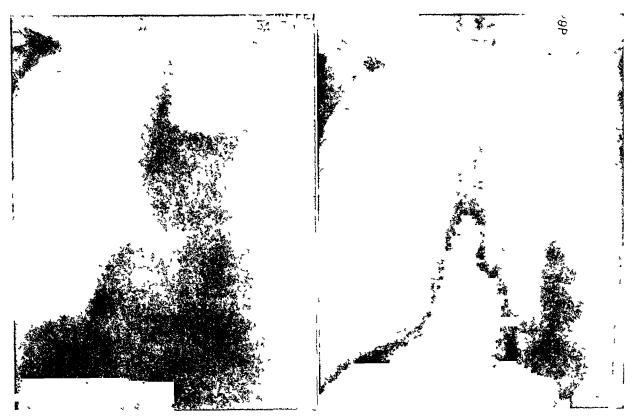


Fig. 1.

Fig. 2. Three months after onset of illness.

sented many of the symptoms characteristic an acute surgical abdominal condition. of This article and that of Doria² published about the same time are the only reports in the literature that we have been able to find of the occurrence of hemopneumothorax without preceding trauma. The former report is of especial

¹ Hurythal, L. M. An unusual case of spontaneous idiopathic hemopneumothoral with certain features resembling an acute surgical abdomen. New England J. M., 198: 687, 1928.

² Doria, R. Emopneumotrace spontaneo con versamento bloccato. Riforma med., 44: 552, 1928.

such procedure would be fraught with grave danger.

During the past year we have followed a case that resembles Hurxthal's in practically every detail, and the striking similarity of the two, we believe, warrants the reporting of this rare and interesting condition.

R. Z., a twenty-year old Cuban office worker, was referred to this hospital by his physician on May 3, 1929, with the provisional diagnosis of acute appendicitis. He had been well previous to twenty-four hours before

^{*}From the Department of Medicine, College of Physicians and Surgeons of Columbia University and the Presbyterian Hospital, New York City. Submitted for publication November 28, 1930.

admission when he felt a sudden, steady, sharp pain in the left shoulder while riding comfortably in the subway. The pain later

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spread to the precordium and came to be worse on inspiration, making it difficult for him to breathe. He went to bed but was unable to sleep because of dyspnea, while the pain persisted and gradually extended to include the whole left chest. Twelve hours after the onset of his symptoms he developed a pain in the mid-epigastrium which spread over the entire abdomen and was most severe just below the xiphoid cartilage and in the right lower quadrant. There was no vomiting, cough or hemoptysis.

Past History: He was always healthy until two years before admission. Since then he has had frequent colds winter and summer, but worse in winter. He had chicken-pox at six years, mumps at ten years, and influenza in 1923. Eleven months before his present illness he had pleurisy without effusion on the left side, and was in bed for five weeks. He has had no chronic cough, no night sweats, and no hemoptysis. The family history was essentially irrelevant.

Physical examination showed a well-developed and well nourished lanky boy slightly dyspneic but not orthopneic. He was quite pale and without evident cyanosis. The pulse was slightly rapid but full and of good quality; the blood pressure was 104/70. The left chest

barely moved with respiration; it was markedly hyperresonant throughout except below the level of the sixth rib, where there were flatness and egophony; tactile fremitus and breath sounds were absent, and the spoken and whispered voice sounds were greatly diminished. A definite succussion splash could be heard.

The right chest was resonant and clear with breath sounds that were slightly high pitched. The trachea was deviated to the right, and the heart was displaced to the nipple line on the right side.

Examination of the abdomen showed diffuse rigidity. Both recti were spastic and there was moderate tenderness (direct and rebound) over McBurney's point and below the left costal margin. On rectal examination there was tenderness on all sides, somewhat more marked on the right and posteriorly.

A blood count showed 3,100,000 red cells, 60 per cent hemoglobin (Sahli), and 19,400 leucocytes with 81 per cent polymorphonuclears.

The possibility of there being an acute surgical lesion in the abdomen was considered, but after a careful and complete physical examination had been made it was felt that the abdominal pain, rigidity and tenderness were secondary to the condition in the thorax.

Exploratory thoracentesis of the left chest (seventh interspace posteriorly) yielded pure blood, which was sterile on culture. Radiograph of the chest taken while the patient was in an upright position showed a large amount of fluid in the left chest with a very definite fluid line at the level of the fifth rib posteriorly. At the top of this fluid the lung was collapsed and replaced by air. The heart shadow was displaced to the right, and the right lung field was clear. (See Fig. I.)

Treatment was conservative consisting of complete rest with liberal amounts of sedative and several small careful thoracenteses. At the end of the patient's first week in the hospital a transfusion of 500 c.c. of blood was given, and another of 400 c.c. at the end of the third week. After fourteen days, weekly thoracenteses were done, and from 400 to 500 c.c. of bloody fluid were removed each time until after the fifth procedure when the fluid had become so viscid that only 60 to 150 c.c. could be obtained. Seven thoracenteses in all were performed.

The patient slowly but steadily improved. For about ten weeks he had a low grade fever with daily rises in temperature to 100.6-101°F., but the course thereafter was practically afeb-

rile. Frequent radiographs of the chest, and the physical signs demonstrated a gradual absorption of the air, a progressive re-expansion of the collapsed lung, and a return of the heart toward its normal site. Two and a half months after his admission, the use of blow bottles was permitted, and a week later the patient was allowed to get up. On discharge, fourteen weeks after the onset of his illness, only a small amount of fluid still remained. The left chest showed some flattening and the intercostal spaces on that side were narrowed. The red blood cell count was 5,950,000, and hemoglobin 105 per cent (Sahli); there were 14,400 leucocytes with 64 per cent polymorphonuclears.

Although the previous history of pleurisy suggests a tuberculous condition, no direct evidence of tuberculosis or of purpura could be found. Repeated sputum examinations (14) showed no acid-fast organisms, and the bleeding time, clotting time and blood platelet count were normal. No shadows suggestive of tuberculosis could be seen in the radiograph of the right lung, or of the re-expanded left lung. The thoracentesis fluid was persistently sterile on culture, and produced no tuberculous lesions when injected into a guinea-pig.

After a short rest in the country the patient returned to his home in Cuba. A radiograph of the chest taken about four months later, which he very kindly sent us, shows the lung fields to be clear, and the fluid almost completely absorbed. There was still some retraction of the left chest as evidenced by the somewhat narrow intercostal spaces. (See Fig. 3.)

Six months after his discharge (nine months after his accident) the patient reported that he was doing very well. He had gained weight steadily, had returned to work, and was free of all symptoms the least bit suggestive of his former illness.

SUMMARY

A case of spontaneous hemopneumothorax is reported in which the abdominal signs simulated those of an acute surgical lesion. No definite evidence of tuberculosis could be found. Treatment was conservative with several small thoracenteses. Improvement was gradual and complete.



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- * Continued from p. 314.

NEW ABDOMINAL RETRACTOR*

NORMAN TAUBE, M.D.

NEW YORK

HERE are many abdominal retractors on the market: They are either "self-retaining" or movable. The

It consists of a cross bar and handle made of very light, but strong steel. The bar is 8 in, long and 34 in, wide, and has the appear-

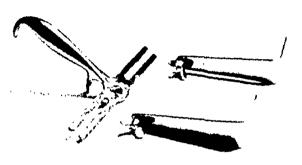


Fig. 1.

self-retaining retractors give sufficient tissue exposure but are difficult to handle, are time consuming in application and exert too much force to maintain in position. The movable retractors on the other hand are easily applied and manipulated, but the area of exposure is small and to expose a large field several retractors are required. Consequently several assistants are necessary.

To secure an instrument that is easily manipulated, that exposes a larger area, and reduces the number of assistants, I have designed the retractor described here:

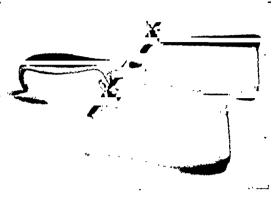


Fig. 2.

ance of two tuning forks fused together. Into each end of the bar a blade is inserted and made tight by means of a winged nut. A retractor with two blades is thus obtained. The blades can be turned in to any angle, in case the exposure of a corner be desired. They can also be moved along the bar to fit the size of the incision.

I have used this retractor and found it easy to manipulate, and to give adequate tissue exposure with fewer assistants.

* Submitted for publication December 31, 1930.



THE SLOUGH AFTER INJECTION TREATMENT OF VARICOSE VEINS*

Joseph K. Narat, M.D.

CHICAGO, ILL.

ISTORY repeats itself. When a new drug is synthetized, a new biological product isolated or a new procedure devised, a wave of enthusiasm follows the introduction of the method. When salvarsan made its first appearance it was hailed as a panacea for the entire line of human ailments. Mercurochrome and insulin have been used as therapeutic agents in an endless variety of diseases. Gradually the enthusiasm subsides and the field of usefulness of the drug becomes limited to those ailments where it really proves effective.

When the injection treatment of varicose veins was first advocated and tried on a large scale by Linger, Sicar and Nobl, working independently, a deluge of favorable reports followed in every country. No untoward reactions were mentioned in the literature until recently. Theoretically three different dangers are possible: (1) pulmonary embolism; (2) infectious thrombophlebitis; (3) local necrosis. Experience showed that the first complication can be practically disregarded provided that a careful technique and necessary skill are used. A septic thrombophlebitis is a very serious complication but fortunately of rare occurrence. On the other hand, local reactions seem to be more frequent than can be judged from the reports. This lack in the literature can be ascribed only to two factors: (1) incomplete presentation of the facts by the authors of papers on this subject. Being enthusiastic about their pet solution or looking at their method of injections through rose colored glasses they are likely to forget the small percentage of cases where a slough occurred. (2) Lack of publications of bad results by physicians who do not treat many patients with varicose veins and therefore do not have the opportunity

to acquire great skill. It is only natural that those physicians who treat hundreds of such patients and make thousands of injections possess great skill; hence few or no misfortunes. As the majority of papers dealing with the chemical obliteration of varicose veins comes from the hand of such exceptionally experienced physicians it is obvious that the literature does not give a true picture of the situation. And yet, sloughs after injections occur even in the hands of a skillful physician and the experience in treating such complications should be reported for the benefit of all.

The axiom still stands good: "no irritation-no obliteration." In other words, a chemical which does not irritate the intima of the vein is not capable of forming a thrombus and of obliterating the lumen of the vessel. The endothelium of a vein may be and probably is more sensitive to a chemical irritant than the perivascular tissue but it is only a matter of a higher degree of sensitiveness as no irritant is known to have a selective affinity exclusively for the endothelial lining of the vein and be harmless to the subcutaneous tissues. Therefore if such a substance due to a faulty technique or leakage through the wall of the vein comes in contact with the perivascular tissues, a reaction must be expected. Some chemicals such as sodium chloride or sodium salicylate are violent irritants and may lead to necrosis more easily than some other substances, e.g., sugar or quinine and urea.

Dr. Norman J. Kilbourne¹ deserves credit for calling attention to such cases in the American medical literature. Dr. Eugene J. Garvin² also mentions that he had a case of sloughing after injection of 20 per cent solution of sodium chloride. Several reports of necrosis after injections appeared previously in European maga-

^{*} Submitted for publication November 14, 1930.

zines. Walter K. Fraenkel³ saw several cases of sloughing after injection of sodium chloride. Vogel⁴ and H. Biberstein⁵ report similar experiences.

Unfortunately none of the authors except Dr. Kilbourne devotes any space to the discussion of the treatment of such sloughs.

A necrosis occurred in one of my cases after injection of sodium salicylate. Moreover, I case was referred to me with a slough after injection of quinine and urea; 2 cases where a mixture of sodium chloride and glucose caused sloughing and I patient with necrosis after injection of invertose.

The first sign of imminent necrosis is a bleb which forms if the solution is injected superficially, or, a brownish-black eschar which appears when the injection is made, or the solution escapes deeper into the subcutaneous tissues. In the last-named instance, in the beginning the cutis is affected but the epidermis is intact. As long as this is the case an application of any of the popular antiseptics such as mercurochrome, hexylresorcinol or acriflavine and a sterile dressing may be applied in order to prevent a secondary infection. Soon, however, the necrosis works its way to the surface. At this stage hot applications of saturated solution of boric acid. two parts, and alcohol 96 per cent, one part, covered with wax paper, proved to be very beneficial. Not only do they alleviate pain if there is any but they hasten the demarcation of the escharotic tissue. Only one patient complained of considerable pain; the rest described the sensation as smarting; the ulcers seemed to be remarkably indolent. The compresses were applied when the patient stayed home; they were changed every two hours; the rest of the time an indifferent ointment covered the ulcer.

From the moment when the hard, black, adherent necrotic tissue was separated from the underlying raw surface of the ulcer the treatment was directed towards epithelialization of the ulcer. The following procedure proved to be the most successful. The patient is instructed to assume a horizontal position whenever possible and

cautioned not to stand on his feet too long at a time. The use of elastic stockings or bandages is not advisable as it interferes with circulation of air and prevents the perspiration from evaporating. For the same reasons only a very thin layer of gauze is applied over the ulcer. Quartz lamp treatments stimulate the granulations but too much expectation from phototherapy may prove disappointing.

Hot applications are discontinued and the patient is instructed to apply twice daily the following well known ointment:

\mathbf{R}	Argent. nitr	0.15
•	Balsam Peru	1.5
	Lanolin	
	Petrolataa ad	15.0

Scarlet red ointment did not prove as effective as this salve.

Every second day the physician cleanses the ulcer with peroxide of hydrogen and touches the edges and the bottom of the ulcer with 10 per cent silver nitrate solution. If the discharge is profuse, application of pyoktanin blue as a dusting powder helps to check it very promptly.

Many other ointments and powders were tried; it would be rather confusing to enumerate all of them; none gave such satisfactory results as this treatment.

In one case Unna's boot was applied and the patient allowed to walk around. The pain subsided but when after six weeks the boot had been removed the ulcer was somewhat smaller but far from being healed. In subsequent cases I abstained from the use of Unna's boot as it prevents application of any other methods.

It goes without saying that as long as the ulcer is not healed the injections should be discontinued as there is no way to determine the limits of the infection.

An attempt to excise the sloughing area must be regarded as heroic. When the ulcer is covered with healthy granulations and its size is considerable a skin transplantation may be justified but should not be attempted until all necrotic tissue disappears.

[For References see p. 306.]

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· E D I T O R I A L ·

THE FUTURE OF DEEP ROENTGENOTHERAPY

C HORTLY after the discovery of the roentgen rays, notable success was achieved in x-ray treatment of superficial malignancy, but the hope thus inspired in the battle against cancer was promptly tempered by the realization that the type of instruments and tube available were not sufficiently penetrating for serious interference with lesions more deeply seated. The discovery of radium, carrying with it the possibility of introducing powerful foci of radioactivity into the interior of malignant growths through fistulae or through natural body cavities, afforded new means for the direct application of radiation of a wave-length of far greater penetrating power than that supplied by the most powerful x-ray installation available until the present time.

Physical investigations made clear that to achieve higher penetrating power with x-rays, it was necessary to utilize much higher voltages. Larger treatment areas and cross-fire applications were employed. The skin was guarded against the damaging effects of the relatively useless softer rays by passing the x-ray output through a filter, at first of leather, then of sheet aluminum, and finally of heavier metals, such as copper and zinc. Yet measurement of the distribution of the larger deep dose thus obtained showed insufficient uniformity of radiation and much to be desired as to penetration.

It was sought to remedy this defect by utilizing a new principle of distance radiation, placing the x-ray tube at a greater distance from the part, an innova-

tion which, because of the inexorable inverse square law, necessitated a very great prolongation of the treatment time to deliver the same amount of depth radiation. However, although the depth effect was much greater and somewhat more ideal, it was still clinically far from satisfactory.

Great progress was being made in instruments; the invention of the hot cathode Coolidge tube, the introduction of stabilizers, the utilization of improved ionization methods of measurements of both superficial and deep x-ray intensities, all helped to place deep x-ray therapy upon a sound and logical basis.

Meanwhile the thought was gaining ground that even harder radiation than that furnished by x-rays might be desirable. Cases were often encountered in which an apparent failure was converted to success by substituting radium for x-ray therapy. Radium and its emanation, radon, were placed in needles and in seeds for interstitial implantation, thus bringing the battle against cancer to the phase of handto-hand conflict by applying the powerful radiant sources in actual contact with the tissues. Needles and seeds could be distributed almost at will throughout the tumor area, at times aided by surgical procedure to uncover the malignant growth. But this method was found to have serious drawbacks in that the effect was really not a uniform distribution of the radiation; the tissues in immediate contact with the radiferous tubes and needles or seeds received an effect so pronounced as to produce liquefaction necrosis while a short distance away the effect was not even sufficient to depress the growth of the malignant cells. The inverse law was found to be true for all radiation, including that of radium. Careful measurements of radium containers revealed that of one hundred units or radiation delivered to the tissues in immediate contact with the radium, only a small fraction reached the tissues a short distance away. For example, a uterine tumor irradiated by a tube of

radium placed in the uterine canal receives an overdose in the immediate vicinity of the radium container and an insufficient dose 3 or 4 cm. away. Tumors treated by radium seeds or needles present on microscopic section a honey-combed aspect revealing these foci of necrosis due to overdosage with surrounding zones of insufficiently irradiated tissues.

Radium therapists have sought to remedy the defects just described by the adoption of the same principle used in deep x-ray therapy, namely, "distance radiation"; the radium "bomb" or radium "cannon" was devised to introduce the factor of distance of the part treated from the radiant source, but with the inevitable result of multiplying the milligram-hours of application, according to the law that the intensity of the radiation diminishes inversely as the square of the distance. Radium applications of this distance type involve such large amounts of radium and such prolongation of treatment that doses are talked of in gram-hours instead of milligram-hours. The devotion of a gram of radium to one patient for from ten to thirty or forty hours at once reduces the proportion of patients who may receive the benefit of radium as compared with the multitude requiring it, and even then such methods are practicable only in large institutions endowed with a gram or more of this expensive element. According to figures supplied by the American Society for the Control of Cancer the total amount of radium owned in quantities of 75 mg. or over in the United States is less than 100 gm., an investment worth about six millions of dollars.

Within the last two years a new development in x-ray therapy has been seen in the production of apparatus capable of generating still more penetrating rays. Whereas in 1913, when Coolidge put his first tubes on the market, by the expression "deep therapy" one meant a pulsating current with a voltage of 125,000 to 130,-000, until recently a voltage of 200,000 was considered the minimum for efficient deep

roentgenotherapy. But now one hears of immense installations with enormous tubes producing x-rays at voltages from 500,000 to nearly a million. At least one installation for 900,000 volts is in experimental use at present in the United States with an output of ultra-penetrating x-rays equivalent to the gamma rays of an enormous quantity of radium at a fraction of the cost of radium. These more penetrating rays really have a short wave-length comparable to that of the shorter gamma rays of radium, so that German authorities talk of "gammavolt" x-ray equipment. With this newest x-ray apparatus the distance of the tube from the patient will have to be greatly increased, but this will be compensated for by the greatly improved quality and quantity of radia-

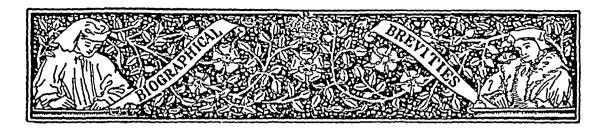
tion. Thus we see promise of achievement of the ideal of an abundance of "gamma" radiation applied at a considerable distance from the part under attack.

No one knows for sure what the outcome will be, but it seems pretty safe to believe that the results will be better. There will of necessity be a period of experimentation with the ultra high voltage instrumentation before conclusions may be drawn. Progress is being made rapidly, and it seems justifiable to anticipate that while radium continues to be more and more in demand for interstitial and cavity application, its use will need to be supplemented by external applications of high voltage reontgen therapy under the newer conditions.

JAMES T. CASE.



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MAGENDIE'S SOLUTION

RANCOIS MAGENDIE was born in Bordeaux, France, in 1783.

His was a place in medical history because he was the pioneer of experimental physiology in France. He used both physical and chemical procedures in his researches. Also he has been referred to as the modern founder of experimenting pharmacology. In anatomy we refer to Magendie's foramen, the foramen which connects the fourth ventricle with the subarachnoid space. He did not have any use for the usual theories employed in his day, but looked upon medicine as "a science in the making." He did not look upon pathology as "the physiology of the sick man." In physiology he strove to further his findings by a closer tabulation of already accepted facts. It has been written that he likened himself to a ragpicker who wandered through the land of science collecting whatever he found. His work resulted in the discovery of only isolated facts. He did not attempt to connect them and he arrived at no important generalizations. He was firm in his belief as to the value of experimentation on living animals. There is no doubt that many of his experiments were done without any ultimate object in view and were truly cruel. Because of this he

has had the particular aversion of the anti-vivisectionists.

Magendie founded the first periodical devoted exclusively to physiology, The Journal de Physiologie Experimentale. His greatest contributions to science were his experimental proof of the truth of Bell's law, his investigations with the mechanism of deglutition and vomiting, and the effects of excision or section of the cerebellum. He is also known for his researches of the "circus movement" obtained by lesion of the optic thalamus. He demonstrated the cause of the blood flow in the veins due to the pumping power of the heart, that osmosis through the vessel walls is due to the chemical difference between the blood and the lymph, and that the absorption of fluids and semi-solids is a function of the blood vessels as well as of the lymphatics. He early noted that arterial blood pressure rises with expiration.

Magendie introduced bromine iodine compounds, strychnine, morphine, veratrine, brucine, piperine, and emetine into medical practice. He conducted the first experiment in anaphylaxis or supersensitization of the tissues (1839).

He died in 1855 at the age of seventy-three years.



FRANCOIS MAGENDIE
[1783-1855]



[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

THE THINGS THAT MAKE SURGERY SAFE

C. JEFF MILLER, M.D.

NEW ORLEANS, LA.

LL surgical procedures fall automatically into two great groups, the surgery of necessity and the surgery of election. The surgery of necessity is urgent surgery because it is done for conditions which threaten life. The surgery of election lacks the element of urgency, because, while it adds to the patient's comfort and increases the patient's wellbeing, it is done for conditions which do not threaten life. Between the two extremes, of course, lie a vast number of diseases, varying from those which will ultimately and inevitably cause death if they are not surgically treated to those in which the probabilities of a serious termination are very remote indeed.

It is perfectly obvious that the surgery of necessity is infinitely more serious than the surgery of election, but it may not be so obvious that in at least one sense the responsibility of the surgeon increases in inverse proportion to the simplicity of the procedure. Let me illustrate. The man with an acute intestinal obstruction, let us say, is doomed to swift and sure death unless surgery is instituted and is instituted without delay. But the woman with a lacerated perineum, let us say, while she may be uncomfortable and while she may

become progressively more uncomfortable, stands absolutely no chance of dying if the injury is not corrected promptly, or, for that matter, if it is not corrected at all. But there is still another phase of the problem. The one patient will certainly die if surgery is not done, the other, who certainly will not die if surgery is not done, may possibly die if it is. It is a remote possibility, I grant, but it exists and it cannot be ignored. The one patient has no choice. He must submit to surgery or he must die. He may die in spite of operation, but he will undoubtedly die without it. The other patient, however, must decide for herself whether she would rather endure suffering and inconvenience, secure in the knowledge that it will never be more than suffering and inconvenience, or would prefer to submit to an operation which will cure her disease but which involves a certain degree of risk, a minimal degree, it is true, but still a risk.

I have chosen extreme instances, I admit, but I have done so purposely. I have chosen to illustrate my point by a condition which is inevitably fatal without surgery and a condition which is practically never fatal without it but which may be fatal with it, because I desire to stress as strongly as I

^{*}Read before the sectional meeting of the American College of Surgeons at Oakland, California, April, 1931.

can the responsibility of the surgeon who advises and undertakes elective operations. The man who does emergency surgery—the comparison is not my own—is rescuing a drowning person, whereas the man who does elective surgery, even though he later rescues his victim, first throws him into the water and subjects him to the chance of sinking. It follows, therefore, that it is the bounden duty of the man who undertakes operations of election to render their risk as small as it can be made.

I would say that the first principle of safe surgery is the realization on the part of the surgeon that every operation, especially every abdominal operation, carries with it possibilities of danger which should not be minimized, which cannot be altogether guarded against, and which are appreciated to the full exactly in proportion to the wisdom and the experience of the man who performs it.

It must never be forgotten that it is the patient who pays the price of the surgeon's mistakes. From that law there is no repeal. Indeed, it might be well for us to remind ourselves constantly of a thing that we are in much danger of forgetting in these overly-scientific days, that the center of the surgical universe, if I may so express it, is the patient himself. He is the person chiefly concerned in every operative act. He submits to surgery for one of two reasons, to save his life or to improve his health. He and not the surgeon is the ultimate judge of the success or failure of every operation. To him, surgery is always an evil and he wants to be certain of the necessity for it, not in an abstract case but in his own personal case. He is not grateful for the performance of a perfect technical operation if it does not happen to be indicated for the relief of his particular disease. It is quite possible, from his standpoint, to have as the end-result of surgery a perfectly healed wound and a permanently impaired function.

"When failure occurs in surgery now," says Lord Moynihan, "it is the individual who fails, and not the methods of which

Lister has laid the eternal and unshakeable foundations," and Garrison echoes him when he says that Listerian surgery is almost as reliable a science as bookkeeping. The safety of surgery, you see, depends not so much on methods as on the manner in which the individual surgeon applies those methods. The safety of surgery is far more a matter of the personal equation than a matter of details of technique. Let me read you a few sentences which I found the other day in an English text. I do not know who wrote them, but I do know that whoever he was, we may take him to be a very wise and discerning gentleman.

In the old days, [he says], the master surgeons were of the elect. Only a few were fitted for the work, and they were fitted by reason of their practised dexterity, their knowledge, their judgment, their readiness of resource, and by a hundred fine, brave, manly qualities that make them great men. But today, thanks to the dual blessing of anesthesia and asepsis, every man who determines to be a doctor rather than a linen draper is able to obtain a patient and may tamper with the innermost secrets of the human body to the end that he may effect a cure. It has been made easy for the sons of Aesculapius to take too much upon them.

He is quite correct. It has been made far too easy for the sons of Aesculapius to do as they would in the lines of surgical endeavor. And surgery will never be as safe as it should be until we return to first principles, until we insist that no man shall be permitted to practice it unless he is possessed, unless he proves himself to be possessed, of at least four things, a natural aptitude, adequate knowledge, sound judgment, and that quality which, for lack of a better name, we call the surgical conscience.

I am far from believing that good surgeons cannot be molded out of most unpromising clay, for I have seen the miracle happen many times, but I have never seen a man become a good surgeon who did not have at least some natural aptitude. I have never seen a man, whatever his other qualifications, become a good

surgeon who did not like to do things with his hands, who did not know how to use his hands swiftly, gently and surely. We are fond of saying, and we are quite correct in saying, that there is more to the practice of surgery than mere craftsmanship. But let us not forget the tremendous importance of craftsmanship. The surgeon must do his work swiftly and accurately, he must, in his actual performance, as Lord Moynihan says, make of surgery a merciful art. The fact that under anesthesia operations can be done deliberately today must not be construed to mean that time is of no consequence. Time is of very great consequence. An operation that is unduly prolonged increases the patient's risk and is usually a very clear indication that the surgeon who is doing it frankly does not know the mechanical part of his task. I have heard in a half dozen forms, as I am sure all have, the story of the interne who was asked by a visiting doctor what was the difference between the widely variant results obtained for the same operation by two very prominent surgeons who operated in that special hospital. And the interne, it will be remembered, whose discernment must have been vastly greater than his tact, replied promptly that the difference was about thirty minutes. That is a story that could be well taken to heart and pondered by us all. The tissues of the human body can be insulted up to a certain point; after that point the retribution is swift and sure, and the surgeon who does not know how to be dexterous will do well to remember that fact.

In the second place, surgery is not safe unless the surgeon knows not only how to cut but also when to cut and where to cut. We have a right to take for granted that he possesses certain general knowledge; we ought also to have a right to take for granted that he possesses a detailed knowledge of surgical anatomy. For more than twenty-five years I have been preaching to students, without ceasing, and, I regret to say, without any very noticeable

effect, that the only way to learn surgical anatomy is to learn it on the cadaver. The pathology of the living must be studied on the living subject, but surgical anatomy can be learned only at the autopsy table and upon the cadaver.

I should regard it as a mighty step forward if the American College of Surgeons should add to its requirements for admission to fellowship the requirement that every candidate present evidence that he had taken a course in cadaveric surgery, and that he had taken it under the supervision of an expert in that field. If such a requirement were made a prerequisite to the practice of surgery, it would work no hardship to the profession and it would work untold good to the victims of our surgical endeavors. It would sweep away forever the type of surgery which I can only call experimental, which is done so generally today and which merits our unqualified condemnation.

The man who is trained in surgical anatomy knows, immediately he opens the abdomen, the significance of what he sees before him. He knows the location, both absolute and relative, of organs and nerves and blood vessels, of muscle planes and fascial sheaths. He realizes that every individual differs in the details of his bodily structure, and that knowledge, when he is working in the neighborhood of vital organs and blood vessels, may mean the difference between life and death for his patient. He begins his work, not with a casual manipulation of whatever structure first meets his inquisitive fingers, but with a systematic identification of landmarks, an orderly inventory, as it were, of normal and abnormal conditions. He is a safe surgeon, I say again, because he knows his way about the field in which he does his work.

The man who possesses this knowledge and who uses his hands well is, whatever his other deficiencies may be, an outstanding surgeon. My secretary has long contended that even an untrained lay person could walk into an operating room

and tell within a few minutes whether the 328 surgeon handling the case were competent or incompetent. I used to question her contention, but I have come to believe that she is correct: it does not take any specialized knowledge to comprehend whether or not a person engaged in a mechanical task knows what he is doing and is doing it as it should be done.

But surgery which stops at this point is not safe surgery. Craftsmanship is of little worth, knowledge is of little worth, unless they are allied with surgical judgment. Now surgical judgment is partly based upon intuition, but it goes far beyond it. It is surely based upon knowledge. It is surely based upon wisdom, which is the application of knowledge. And it is chiefly based upon experience, which is the interpretation of what we have seen and done and thought, or the interpretation of what others have seen and done and thought and we have been wise enough to profit by. If, as some cynic has said, experience is the name we give our mistakes, it is likewise, if we are receptive, the touchstone by which we interpret life, and surely it is the founda-

Finally, no surgery can be safe unless the tion stone of judgment. surgeon who performs it adds to his other qualities of mind and heart the greatest of them all, the thing that we call the surgical conscience. One need not necessarily operate in order to possess it. It is possessed in fullest measure, I would say, by the men who would like to be surgeons but who are not because they are honest enough to admit to themselves their lack of fitness for the task. It is the quality which makes the surgeon unwilling to operate until he is sure in his own mind that his

training is adequate and his skill is sufficient for him to dare to lay hands upon the human body. It is the quality which makes him more than willing, which makes him eager, to accept the guidance of the man who knows more than he does of special diseases and special procedures. It is the quality which makes him call for assistance promptly and freely when he sees himself drifting beyond his depths. It is the quality which stays his hand from unnecessary surgery, which drives his hand to the surgery of desperation, the surgery that sullies his record, as he knows it cannot fail to sully it, but that gives to dying men and women their only chance of salvation. It is the quality that makes him realize the high seriousness of his calling, that makes him earnest in his purposes, honest in his mental processes, steadfast in his endeavors, courageous in the tribulations that are the inevitable lot of the physician who has chosen to be a surgeon.

Matters of technique are important, but they need not be emphasized to the surgeon who possesses the qualities I have just named, natural aptitude, knowledge, judgment and the surgical conscience, for if he possess them, he cannot fail to possess their fruits. Safe surgery is not a matter of chance any more than it is a matter of complex details. It is first and foremost a matter of sound principles, a matter of the application of sound principles, and the responsibility of their application is the responsibility of the individual surgeon. Let him see to it, then, that he is what he should be, that he does what he should do, for upon his shoulders rests the heavy task of making surgery safe.

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BOOK REVIEWS

SIXTY CENTURIES OF HEALTH AND PHYSIK. By S. G. Stubbs and E. W. Bligh. With an Introduction by Sir Humphry Rolleston, Bart. 253 pp. New York, Paul B. Hoeber, Inc., 1931.

To describe the history of medicine acceptably in a few hundred pages is in itself a very considerable achievement; but to prepare a book on the subject containing many fresh facts presented in a fashion appealing both to lay and medical readers is a circumstance deserving of some comment. The point of view of the authors is detached and refreshing and the text has throughout a literary flavor and light touch which makes it singularly attractive.

The first ten and the nineteenth chapter are by Mr. Stubbs, who draws freely upon his intimate knowledge of modern archeological research. He draws attention to the ironical fact that the earliest human remains, i.e., Pithecanthropus erectus, suffered from a modern malady. Mr. Stubbs is evidently much interested in the history of hygiene and sanitation and he gives us a most illuminating account of the sanitary system found in the Mesopotamian district 4000 B.C. and in Rome and the Roman colonies. His account of Greek and Roman medicine is excellent and can be warmly recommended. He falls into the common error, however, of describing Galen's given name as Claudius, the Cl. in reality standing for Clarissimus.

Bligh is responsible for the second half of the book, Chapters XI to XVIII and XX. He begins by telling the story of The Royal Society and presents a vivid picture of all the scientific ferment of the period of The Restoration. Bligh would seem to have a nodding acquaintance with all of the chief personalities and he refers to each of the early members of The Royal Society as old friends. The most notable section in the book is Chapter XIII, The Microscope and the Discovery of Germs. This represents a first rate contribution to medical history and contains a number of new and important facts relating to the early history of the germ theory. Kircher's description of "the little worms that cause the plague," excellently translated by Mr. A. M. Muirhead, makes it evident that the learned Jesuit is entitled to an important place among the early writers on the germ theory. The most interesting disclosures, however, are the passages from Marchmont Needham's "Medela Medicinae"; Needham seized upon Kircher's theory and seemed to appreciate its far-reaching significance. The account of Sydenham in Chapter xiv is very happy and the chapter on the Eighteenth Century is also very well done. The book can also be recommended for its wealth of well chosen illustrations (64 full-page plates), very few of which are encountered in any other history of medicine.

Nasenplastik und Sonstige Gesichtsplastik, Nebst einem Anhang Über Mamaplastik ein Atlas und Lehrbuch. By Prof. Dr. J. Joseph. 3 vols., Leipzig, Curt Kabitzsch, 1931.

Dr. Joseph's monumental atlas on plastic surgery is now complete. Part 1 appeared over a year ago. Parts 11 and 111 just published, complete the work.

The subject of plastic surgery of the face and of the breast is covered in a most satisfying manner. Over 1718 splendid illustrations, many of which are colored, depict each operation, step by step. The accompanying text is clear and authoritative. Every man doing any plastic surgery should have this book available and even those who cannot read German will find the illustrations of extreme value. The subject is covered with true German thoroughness. Even the historical aspects are considered and the reproductions of illustrations from the famous work of Tagliacozzi (Venice, 1597) are splendid. The results obtained by the author are quite remarkable as demonstrated by the "before and after" pictures. The work is divided into general and special parts, the first taking up the general and anatomical and artistic aspects of plastic surgery. The second or special part takes up the pathology and the classification of deformities along pathological lines.

Commendation must be added for the quality of the illustrations. It would indeed be difficult to improve upon them and even the severest critic will admit that not any of the 1718 illustrations should be omitted. There is no evidence whatever of padding and there is not the annoying number of illustrations of special instruments that so often mars works

of this kind. It is interesting that many of the cases illustrated were as long as ten years after the operation. This is a work of which the author and the publishers may well be proud and no surgeon will regret the time given to its study.

ACCIDENTAL INJURIES, THE MEDICO-LEGAL ASPECTS OF WORKMEN'S COMPEN-SATION AND PUBLIC LIABILITY. By Henry H. Kessler, A.B., M.D., F.A.C.S., F.A.P.H.A., 698 pp., Phila., Lea & Febiger, 1931.

This book takes up the legal end of disabilities and any physician having to testify in court or before an arbitration board will find it of extreme value for reference. With many years of experience as head of the New Jersey Rehabilitation Clinic, Dr. Kessler is almost in a unique position to write this book and every page of it has the benefit of his tremendous experience.

THE RATIONAL TREATMENT OF VARICOSE VEINS AND VARICOCELE, WITH NOTES ON THE APPLICATION OF THE OBLITERATIVE METHOD OF TREATMENT TO OTHER CONDITIONS. By W. Turner Warwick, M.A., M.B., (Cantab.), F.R.C.S. (Eng.), 176 pp., London, Faber & Faber, Ltd., 1931.

This book is best described in the opening paragraph of the author's Preface: "These teachings are based on the results of investigations primarily undertaken to find answers to a few of the occasionally irritating, sometimes stimulating, but ever persisting whys of medical students. They have stood the test of my own practice for three or four years, and are now presented in the hope that they may prove of service to the practitioner who has met with the same difficulties."

Well and concisely written, the work covers the ground intended in a very satisfactory fashion.

PROGRESSIVE MEDICINE, A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES AND IMPROVEMENTS IN THE MEDICAL AND SURGICAL SCIENCES. Edited by Hobart Amory Hare, M.D., LL.D. Assisted by Leighton F. Appleman, M.D., 339 pp., Vol. 2, Phila., Lea & Febiger, June, 1931.

The June 1931 number of Progressive Medicine arrived simultaneously with the news of the passing away of the Editor, Dr. Hobart Amory Hare. This volume, therefore, is of a special interest as being the last under the editorial direction of the founder of this splendid series. It contains the following articles: Hernia, Surgery of the Abdomen, Exclusive of Hernia, Gynecology, Disorders of Nutrition and Metabolism; Diseases of the Glands of Internal Secretion; Diseases of the Blood and Spleen, and Ophthalmology, each of which is a concise, thorough and up-to-date discussion of the subjects covered. This quarterly review has been a welcome visitor for a great many years and it is hoped that a new Editor will be found to keep it up to the high standards set by Dr. Hare.

OPERATIVE SURGERY, GENERAL AND SPECIAL CONSIDERATIONS. By Dr. Martin Kirschner, Professor of Surgery and Director of the Surgical Clinic at the University of Tubingen (Germany). Authorized translation by I. S. Ravdin, B.S., M.D., 642 pp., 746 illus., mostly colored. Phila., Lippincott, 1931.

In taking up this volume one is first of all impressed by the remarkable wealth of splendid illustrations. In less than 700 pages there are over 700 illustrations of as fine a grade as we have seen in any medical publication. The volume is by no means a textbook or practice of surgery. It is an operative surgery for the practicing surgeon divided into eleven chapters as follows: 1. This takes up the question of the Operating Room, The Operator and His Assistants, The General Examination and Management of the Patient, Position of the Patient During the Operation, and General Principles of Operative Technic. 11. The Control of Pain, General Anaesthesia, Local Anaesthesia, Venous Anaesthesia, and Spinal Anaesthesia. III. The Control of Infection, The Aseptic Operation, Aseptic Technic of the Operative Set-Up and of the Wound, Conduct of the Operation in an Infected Field-Primary Care of Traumatic Wounds, Operative Management of Local Infection, and Changing of Dressings and the Further Care of the Wound. IV. The Control of Hemorrhage, Arrest of Bleeding, and Treatment After Hemorrhage. v. Operations on the Skin and Subcutaneous

Connective Tissue, Incision, Union and Transplantation of Skin, Surgery of the Skin and of the Subcutaneous Tissue, and Restoration of Contour by Tissue Transplantation and Paraffin Injection.

vi. Operations on Muscles, Tendons and Fascia, Division and Suture of Muscles and Tendons, Lengthening and Shortening of Muscles and Tendons, Transplantation of Tendons, Construction of Artificial Tendons, Free Transplantation of Fascia and Tendons.

VII. The Surgery of Bloodvessels, Management of Congenital Vascular Tumors, Vessel Suture, Surgical Treatment of Aneurysms, Arteriotomy, and Treatment of Varicose Veins. VIII. Operations on the Nerves, General Considerations, Resection and Suture of Nerves. Management of Nerve Defects, Treatment of Pathologic Irritability of Nerves, Periarterial Sympathectomy. IX. Bone Surgery, General Principles, Bone Surgery, Open Operations for Fractures and Pseudarthrosis (Non-Union), Management of Defects of Bone, The Correction of Bony Deformities, Nail and Wire Traction, Management of Bone Tumors, and Treatment of Ostcomyelitis. x. Operations on Joints, General Considerations, Arthrotomy-Management of Wounds and Joints, Aspiration of Joints, Drainage of Joints, Excision of Joints, Arthrodesis-Artificial Production of Ankylosis, Arthroplasty-Operative Mobilization of a Joint.

xi. Amputation and Disarticulation, Introduction, The Site of Removal, Incision of the Soft Parts in Amputation and Disarticulation, Care of the Bone, Care of the Vessels, Care of the Nerves, Reamputations and Secondary Plastic Operations, After care of the Stump, Kinoplastic Amputations, and Index.

The text is well written without any waste of words and covers the ground in a masterful fashion. It is one of the most practical books we know of for the general surgeon. No attempt is made to cover all the different operations in each instance, but the operations of the author's choice are given in detail with reference to a few other methods in almost every instance.

Both the Translator and the Publishers are to be congratulated on making this book available to English readers.

ABDOMINAL PAIN. By John Morley, CH.M., F.R.C.S. With an introduction by J. S. B. Stopford, M.D., F.R.S. 185 pp., New York, William Wood, 1931.

This is as interesting a discussion of pain in the abdomen as we have yet seen. The author has made a thorough yet concise study of the subject and has reached conclusions which are entitled to thoughtful consideration even though they may not meet with a complete acceptance in all cases. As Dr. Morley says in his Preface, "The book is mainly the result of personal clinical observations, and has no pretence to be an encyclpaedic work of reference. It is inevitably controversial in tone, and limited in scope to the field in which a general surgeon has opportunities for study."

CHIRURGIE DE L'ULCERE GASTRIQUE ET DUODENAL. By N. Hortolomei and Butureanu. 407 pp. Paris, Masson et Cie, 1921.

In this book of 407 pages the authors review most of the operations which have ever been devised for the relief of ulcer. The book will perhaps be of greater value to the student of the history of the subject than to the abdominal surgeon who is always looking for hints in regard to technique. There is a good bibliography which is very helpful, and there is considerable discussion in regard to the respective merits of medical and surgical treatment of ulcer. Considerable space is devoted to the complications which sometimes follow operations for ulcer. There are valuable chapters on the changes which occur in the physiology of the stomach and bowel following the various operations for ulcer.

Altogether it is an attractive and a useful book for the library of the gastroenterologist and the gastric surgeon.

DIE BAKTERIOLOGIE DER WURMFORT-SATZENTSÜNDUNG UND DER APPENDIKU-LÄREN PERITONITIS (Bacteriology of Appendicitis). By W. Löhr und L. Rassfeld. 105 pp. Leipzig, Georg Thieme, 1931.

It would be a brave man who would attempt to write something new about the bacteriology of appendicitis. Much has been done in the past, but techniques are constantly being improved and often a subject which appears to have been exhausted can be gone over again with profit. The intestinal flora of a normal appendix contains large amounts of B. coli, B. lactis-aerogenes and pneumobacteria Friedländer, also B. Welchii. There are large numbers of streptococcus acidi lactici and actinomyce-

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tum which are perhaps not pathogenic. Occasionally a normal appendix is free from bacteria. The diseased appendix, even when full of pus. often contains the same bacteria that are found normally. With very severe infections there are even fewer bacteria present than are usually found. In gangrenous appendicitis the actinomycetum may dominate the picture. The writers believe that appendicitis is produced by bacteria which are always present, but there is a possibility that sometimes streptococci may arrive by way of the blood stream.

The monograph is well illustrated and there are protocols of the findings in 131 cases.

Polyposis Gastro-intestinalis. By Hans Tonnesen, Acta. Chir. Scandin., 68: 1-224.

This is an interesting monograph based on 40 cases of polyposis of stomach or intestine. The writer believes that the etiology is based upon a combination of hereditary and chronic inflammation. Actually, the writer might have brought out more clearly that there are three main types of polyposis of the colon; one in which the peculiarity is hereditary and perhaps congenital, another in which the cause is chronic ulcerative colitis, and a third in which the etiology is unknown.

Tonnesen believes that in 65 per cent of the cases of carcinoma of the colon the disease began as a polyp. He believes that gastric polyposis is based on a chronic gastritis. Polyposis of the digestive tract occurs twice as frequently in men as in women. The commonest symptoms are diarrhea, intestinal bleeding and pain in the lower part of the abdomen. Treatment in most cases must obviously be surgical in nature.

There is a bibliography, but no index.



PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

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PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

CHAPTER XII

THE TREATMENT OF OPERATIVE WOUNDS

The treatment of operative wounds is a task from which there is, of course, no escape for the medical attendant who allies himself at all with the practice of surgery. The actual surgical wound itself is naturally frequently only a means to an end and to that extent can be considered as a matter of relatively minor importance. Usually in major surgery the acutal site of pathology is exposed only once, while the patient is on the operating table, and thereafter is covered by tissues of varying thickness, the only apparent remnant of the manipulation being, in the average case, a mere skin incision. To the patient, the care of the external incision is of the utmost moment, as it represents to him, on the one hand, a source of possible temporary pain, with exacerbations at times of dressing, and on the other hand, a possible source of permanently embarrassing disfigurement. The day of unduly small skin incisions in surgery has largely passed and, as there can be no doubt that a large incision holds more possibilities than a small one for pain as well as ugliness, the medical attendant will do well to perfect himself in those matters which make for the relative comfort of the patient during redressings and for the assurance of a cosmetic effect after healing has occurred as satisfactorily as can be expected under the circumstances. However, neither the matter of comfort to the patient nor the matter of an ultimately good cosmetic effect is the essential desideratum from the medical point of view in any surgical case, but rather the reestablishment of good physiological function, and this especially as it concerns affairs in the depth of the wound.

I. NORMAL PROCESS OF REPAIR IN WOUNDS

In order to care for surgical wounds intelligently it is essential to understand the characteristic changes which occur in such wounds during the process of healing. It has been customary for years to consider in this connection two types of healing: (A) healing by first intention and (B) healing by second intention.

A. HEALING BY FIRST INTENTION: Healing by first intention characteristically occurs in cleanly incised, non-contaminated wounds in which the wound edges have been accurately apposed, and accurate apposition of edges is adequately maintained subsequently. The first histopathological change which can be noted consists of a liquefaction necrosis of such cells as have been devitalized by the operative trauma; this necrosis is minimal and involves merely a thin sheet of cells, both those actually lining the incision and those lying immediately adjacent to the exposed surface. This reaction may be noted within an hour of the time of infliction of the wound, and is accompanied by a retraction of elastic tissue fibrillae from the wound surfaces; the severed blood vessels, being rich in elastic tissue, undergo particularly marked retraction. Due to the opening of lymph and blood vessels there is also, during this period, an outpouring of blood and lymph elements into the wound; the amount of blood elements extravasated should be minimal provided that adequate hemostasis has been secured at the time of operation. 1 At the end of about eight hours the degenerative reaction just described has become maximal, the blood elements have undergone coagulation, and the process of repair begins with the proliferation of epithelial cells across the skin surface and the invasion of the blood clot by connective tissue fibroblasts in the depths of the wound. Vascularization of the new connective tissue occurs by a process of budding of the capillaries adjacent to the wound surfaces, these capillary buds invading the blood clot and eventually bridging the gap made by the incision.

By the end of four days epithelization of the wound surface has ordinarily become complete, and by the end of six or seven days vascular and cellular tissue has replaced the clot between the two wound edges, the debris incident to the autolysis of the blood clot, which is formed in the interim, having been removed by the phagocytic action of the mononuclear leucocytes. Only at the end of approximately three weeks, however, has the process of scar formation become quite complete.

B. HEALING BY SECOND INTENTION: The process of healing by second intention is not essentially different from the foregoing. It applies to wounds which have involved the devitalization of considerable tissue or in which the wound edges have not been accurately apposed originally, or in which they have been insecurely supported in such a position subsequently. In the healing of such wounds the formation of granulation tissue, with its typical capillary loops, is a dominant part of the picture. This granulation tissue invades such blood clots as may form, and in cases in which the blood clot does not completely fill the hiatus between the wound edges, the granulating wound edges progressively grow toward one another and ultimately fuse. By the third or fourth day granulation has usually formed to such an extent as to have formed a bridge of tissue over which epitheliazation begins to take place from the edges of the wound surface.

The characteristics of such wounds when fully healed are the presence of considerable amounts of scar tissue and the absence in the scar of the usual skin appendages, sweat glands, sebaceous glands and hair follicles.

II. THE CARE OF ORDINARY SURGICAL WOUNDS

In clean surgical cases in which primary suture of an incision has been performed without the use of drains or other material surgical expedients, little can be accomplished by the medical attendant as far as the wound is concerned beyond (1) the prevention of infection, (2) the early recognition of

such complications as may occur, especially hemorrhagic or serous accumulations, either obvious or occult, and the occurrence of unavoidable infection, and (3) the prompt and proper removal of suture material as soon as the indications for such removal become manifest.

- A. The Omission of Gauze Dressings Following Abdominal Operations: A number of operators have recently been advocating the omission of all gauze dressings following the closure of abdominal incision in clean cases. The wound is simply allowed to come into contact with the air, being protected from contact with the bedclothing by means of a wire cradle, and healing takes place, according to many observers, more kindly under this form of treatment than in those cases in which gauze is applied. The method has probably not been used extensively enough to permit of its just evaluation, but certainly it is difficult to see how contamination of the operative wound can be avoided in all cases under such a regime, and although theoretically not unsound, the method would seem to present serious practical difficulties, at least as a routine procedure.
- B. Performance of Routine Surgical Dressings: 1. The Importance of Sterility: For at least the first four days following operation in the case of the so-called "clean" or non-infected wound which proceeds to healing by primary intention and often for considerable longer periods in wounds that for one reason or another remain open, it becomes incumbent upon the surgical dresser to use, theoretically at least, the same aseptic precautions that were used in the operating room at the time the original dressing was applied. Actually this would mean at least a five-minute period of scrubbing the hands and the subsequent donning of sterile gown and rubber gloves. Such a procedure would consume, on the one hand, so much time, and on the other, so much surgical material that in the routine case it becomes impracticable. Furthermore, it is usually unnecessary, as the manipulations ordinarily made during the course of dressings are much simpler than those originally

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made in the operating room and can be performed by the intermediation of instruments, It should be taken as a working principle, however, that in the early postoperative manipulation of wounds every redressing is actually an experiment in bacteriology precisely as was the original operating room technique, and in those cases in which, because of the complexities of manipulation required, it becomes no longer possible to use the intermediation of sterile instruments, the more arduous but safer method of operating room technique should. and must, be used. If it is decided in a given case that it will be possible to make all manipulations without touching any part of the wound or dressings with any unsterile object, the medical attendant should at least not proceed to his task without replacing his street coat with a clean hospital garment and giving his hands a thorough washing with soap and running water. Furthermore, when the dressing has actually been completed, and before one proceeds to any other task whatever, especially to the dressing of another case, the hands should again be thoroughly washed. This much is an esthetic as well as a surgical requisite, and any lapses in this part of the technique are apt to be appreciated quite as much by the patient as by one's professional associates. The pouring of alcohol on the hands subsequent to cleansing with soap and water is an added precaution in the interests of safety both to one's self and one's patients which may bring rich, even if unrecognized returns.

Instruments should be presented to the surgeon carefully sterilized and preserved from contamination either in a solution of alcohol, lysol, or other suitable antiseptic, or else dry and protected by a sterile towel or other dry container. Their sterility should be respected, the dresser directing that they be removed from the solution, or dry container, for him by means of sterile forceps, he, in turn, grasping them only by their handles and immediately discarding them in favor of new sterile ones if for any reason the working parts of the instruments become contaminated. The practice of taking instru-

ments from antiseptic solutions directly with the fingers or of returning them after use to solutions or receptacles, which, in turn, contain sterile instruments, or the handling of dressings directly with the ungloved hands, especially the removal of them from sterile bundles or wrappings, is a procedure mentioned only to be condemned.

Nothing so breaks the morale of sterility in a hospital as carelessness in the matter of postoperative surgical dressings, and it would be worth while to exercise the utmost care in this particular part of a surgeon's work for its salutary effect on the nursing staff alone if for no other reason.

2. Removal of Adhesive Plaster and Dressings: The removal of adhesive plaster from a person's skin need not be a painful procedure if time be taken to soften the adhesive side of the plaster, as it is removed, with a little ether, gasoline, benzine, or other suitable solvent. Of course, most of the pain of removal in any case is due to traction on hairs, and as shaving of the environs of an operative wound is universally practiced previous to operation, undue inconvenience to the patient should not ordinarily result from this source. Occasionally, especially in the presence of infection, really acute pain may result from indirect traction on the wound edges during the removal of plaster, but usually a little common sense in applying the force required to peel the adhesive away from the skin will be all that is needed to obviate this. With a little manual dexterity and practice, plaster may be painlessly removed by a quick pull without previously softening it, the latter process being usually reserved for use in the case of unduly sensitive and apprehensive patients. Often the removal of a surgical dressing can be delegated to the attending nurse after the surgeon has washed his hands and is ready to proceed with the actual redressing, but when there is any doubt as to the nurse's ability to remove dressings properly, it may be necessary for the surgeon to loosen the dressings himself before he proceeds to the final preparation of his hands, and subsequently to

removing the dressings with forceps, which, of course, are immediately discarded along with the dressing.

- 3. Reapplication of Dressings: In reapplying dressings to operative wounds the following principles should be respected:
- 1. The dressing should be voluminous enough to absorb the secretions from the wound over a reasonably long period of time without becoming soggy. Obviously the secretion from certain wounds will be more profuse than from others, and some wounds will require more frequent dressings than others; hence, a certain amount of judgment will be required in selecting the proper bulk of dressing material for the individual case.
- 2. The dressing should not be more voluminous than necessary to meet these indications, for bulky dressings must almost of necessity be more or less uncomfortable, and especially in the summertime and in a warm climate, may, in addition, become an actual menace through the accumulation beneath them of perspiration, which is always contaminated by skin bacteria.
- 3. The dressing should be applied neither too tightly nor too loosely; if too tight it will be uncomfortable to the patient, and, in addition, it may be actually injurious because of interference with the blood supply to the part, respiration, or some other important local or general function. If too loose it readily becomes dislodged, and thus fails to perform its protective function properly.
- 4. The dressing should be so applied as to discourage attempts on the part of the patient to manipulate it. Most dressings, for this reason, are best covered securely with adhesive strips; in certain cases these may completely cover the wound, being imbricated from below upward, the lower strips being applied more tightly than the upper ones in the case of abdominal incision, where support is required below and freedom of respiratory motion above.

With respect to the proper time for changing dressings no absolute rules can be formulated, but the following suggestions may be offered:

1. In the case of the average clean laparotomy wound, except in unusually warm weather, it is generally unnecessary to disturb the original dressing until time for the removal of stitches; soiling of the dressing by perspiration, or otherwise, is, of course, an indication for earlier dressing. There is something to be said, however, in favor of a change of dressings even in clean cases about the third or fourth day, and such a procedure is adopted routinely by certain authorities; in this way early suppuration, minor

degrees of vascular oozing, and malposition of wound edges which would otherwise pass unnoticed may sometimes be detected and rectified or controlled by the institution of appropriate treatment.

- 2. In the case of wounds from which exudation is taking place dressings should be changed as often as may be necessary to prevent sogginess; dressings which have ceased to be absorptive through accumulation of secretions have ceased to function as a dressing and have become an undesirable kind of poultice. Daily dressing will suffice in many cases; more frequent, even hourly, dressings may occasionally be required in others.
- 4. Surgical Drainage and the Care of Drainage Material: The indications for the use of drains and drainage material in the treatment of surgical conditions are interpreted much more conservatively now than formerly; for this reason, and also because disease is being diagnosed and subjected to operation earlier than previously, only relatively few cases nowadays present postoperative problems associated with the care of surgical drains.

This statement is true of all surgery, but it is particularly true of abdominal surgery, in which, for instance, drainage of the gall-bladder bed after cholecystectomy is now perhaps as exceptional as formerly it was universal, and many excellent and seasoned surgeons do not hesitate to close an abdomen tightly even in the presence of generalized suppurative peritonitis.

Drains of one variety or another are used for the following purposes:

- 1. To relieve pressure, especially pressure within a hollow viscus, such as the urinary or gall bladder, or some part of the intestinal tract,
- 2. To initiate an irritative process designed to favor the formation of adhesions or rarely to induce erosion of tissue,
 - 3. To facilitate the evacuation of infected or toxic material.
- a. Rubber tube drains: The use of glass, metal, or other tubing made of hard, unyielding material for purposes of drainage, is at the present time virtually obsolete; such material has a distinct tendency to produce local pressure

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necrosis and when used, for instance, in the abdomen is likely to erode either into the lumen of some part of the intestinal tract or the lumen of some sizeable blood vessel, either of which events might prove more or less rapidly fatal. Glass presents an added danger in that it is breakable, and, though the danger of breakage is somewhat remote under ordinary circumstances, the result of such breakage would so inevitably prove catastrophic that the very thought of it should act as an effectual deterrent to the employment of such a substance.

Soft rubber tubing presents the danger of pressure necrosis in less degree than harder materials, though it is not entirely immune to this undesirable effect. The objection to rubber tubing as drainage material chiefly consists in the fact that it is ordinarily inefficient except for relatively short intervals of time. In case dependence is placed on the terminal opening of such a tube, the lumen readily becomes blocked by flakes of fibrin, by the surface of an adjacent organ, or in the case of abdominal drainage by the omentum. For this reason rubber drainage tubes before use are usually perforated along the sides, split along one side, or cut in spiral fashion, so that even though one avenue of exit may become blocked others may remain patulous. Practically, these expedients improve the situation only slightly.

When using rubber tube drainage it is also important to realize that the efficiency of such drainage depends almost entirely, even under the most favorable conditions, on gravity; fluids do not ordinarily discharge uphill through the lumen of a tube, and consequently in order to obtain maximal advantage from such a device relations must be adjusted so that the tube pursues a progressively downward course. This involves care in the original disposition of tubes, but more particularly care in the postoperative position of the patient.

Rubber tubes which are designed to promote drainage and which do not continually discharge drainage material, must in all cases be manipulated unless one can assure oneself (1) that no blockage has occurred and (2) that material requiring

drainage will not subsequently reaccumulate. Under certain circumstances rubber tube drains may be removed, cleaned and sterilized, and reinserted; but this obviously does not apply to tubes inserted through the abdominal wall or tubes inserted in other regions in which the reinsertion of the tube cannot be performed entirely, or at least largely, under the control of direct vision. Usually the expedient adopted in attempting to clear a tube which has become blocked is one of partial withdrawal. Before attempting such a maneuver, however, one should be certain that any sutures of absorbable material which may have been used to anchor the tube in situ have become liquefied, that traction on the tube will not rupture or dislodge important structures, and that portions of the drain will not tear away. These considerations are particularly important in attempting the removal of drains in and about the bile ducts, not only because of the nature of the structures involved, but also because of the depth of these structures from the skin surface.

Rubber tubes when used for purposes of intraperitoneal drainage and when undisturbed are of no further value after a period of twenty-four hours, because within such a period plastic adhesions will surely have been formed to such an extent as to have walled them off completely. The period of effective drainage can often be prolonged somewhat in these cases by withdrawing the tube an inch or two at a time at intervals of several hours, possibly rotating the tube gently during the process of withdrawal; the process of withdrawal can usually be begun within from twelve to twenty-four hours postoperatively.

Rubber tube drains should invariably be provided with some safety attachment to prevent them from inadvertently slipping completely out of sight into the wound; the device commonly used is a safety pin passed through the tube and fastened just beyond the skin surface.

Perhaps the most frequent use of the rubber tube drain at the present time is in drainage of the pleural cavity; for Book Page 454 this purpose it is not unsuitable, as dependent drainage can be induced, tubes can be removed, cleaned, and reinserted without much difficulty and with comparative safety, and the frequent combination of drainage with Dakinization of the pleural cavity tends to maintain the patency of the lumen of the tube.

b. Gauze drains: As a drainage material gauze has been increasingly falling into disfavor during recent years; this is primarily because gauze becomes rapidly soaked with secretions, and once it has become thoroughly impregnated promptly ceases to serve its original function and tends to become a culture tube for bacteria and a plug to prevent fluid accumulations from reaching the surface. The interstices of the fabric become clogged with cellular elements and fibrin, and the rough surfaces presented by the strands of cotton fibers produce irritation of the wound surfaces with which they come in contact. For the latter reason gauze acts as an excellent medium for the stimulation of adhesions and is sometimes inserted into wounds primarily for this purpose rather than for drainage; a gauze pack or drain placed against the parietal pleura will within twenty-four or thirty-six hours cause the visceral and parietal pleurae to adhere firmly together, and a tuft of gauze allowed to protrude from the end of a rubber drain and placed extraperitoneally to an appendiceal abscess will within forty-eight hours cause erosion of the peritoncal wall of the abscess so that the abscess will rupture and discharge its contents along the drain.2

Except on very rare occasions and for very special purposes, like the one just mentioned, gauze should not be allowed to remain in wounds longer than twenty-four hours and only rarely for periods longer than twelve hours.

d. Modified gauze drains: The primary advantage of gauze as a drain lies in its tremendous capacity for capillary attraction, and its consequent ability to provide drainage against gravity, so that the relative position of the patient and the drain does not necessarily have to be such as to produce

dependent drainage. Attempts have been made to combine the advantages of gauze and rubber tubing by placing a roll of gauze within the tubing, or by rolling gauze in a sheath of rubber dam (cigarette or Penrose drain) which amounts virtually to the same thing except that the latter form of apparatus is much more pliable, and consequently not so prone to produce pressure necrosis. When making use of such appliances it should be remembered, however, that the same general principles apply as in the case of gauze alone, and a piece of gauze thoroughly soaked with secretion and possibly also impregnated with bacteria is no more desirable in a wound when enclosed in a piece of rubber than when not so enclosed.

A modification of the Mikulicz gauze drain has been recently used with success; this drain finds its widest usefulness in connection with the treatment of diffuse peritonitis. The original (usually abdominal) incision is left wide open and over it is spread a large piece of rubber dam in which has been previously cut multiple small openings; gauze is now packed into the wound by depressing the piece of rubber dam until the abdominal opening is thoroughly filled and the wound is spread widely.

The value of such a drain is confined to the earliest postoperative hours, and as soon as the gauze has become thoroughly saturated with secretion it should be promptly removed. It should be refilled only in case drainage has been very profuse and fibrin is believed not to have walled off the drain sufficiently to make further drainage impossible.

d. Simple rubber dam drains: Possibly the simple rubber dam drain or some modification of it most commonly meets the need of postoperative drainage. A folded or rolled piece of thin rubber presents a smooth surface for contact with wound surfaces and thus produces a minimum of irritation; it is soft and pliable and consequently shows little tendency to the production of pressure necrosis; its surfaces being in close contact capillary attraction is favored and drainage is not solely dependent upon gravity; it can be readily cut and shaped in

accordance with the particular conditions to which it may be applicable.3

5. The Removal of Stitches: The question of the proper time for the postoperative removal of sutures can be settled only by a consideration of the functions which the latter are designed to perform and the particular conditions present. Two general types of skin sutures are in use at the present time: (1) the superficial or coaptation suture which is introduced fairly near to the edge of the incision, its function being to bring the cut edges of the skin into as accurate approximation as possible and thus avoid unnecessary scar formation, and (2) the deep, relaxation or retention suture which also passes through the skin, but is introduced at a relatively greater distance from the wound edge than the former, and includes a relatively considerable amount of tissue in its bite, usually virtually the entire thickness of the wound, and the purpose of which is to prevent rupture of the wound as the result of unusual and unforescen stresses and strains. The latter type of stitch was used much more commonly some years ago than at the present time; surgeons have come recently to realize more and more that the essential features of successful wound closure are (1) careful and accurate anatomical restoration of the cut tissue planes, (2) the avoidance of so-called "dead spaces," and (3) complete hemostasis, and that when these three fundamental principles are disregarded no amount of trussing or splinting by whatever means will prevent the development of untoward results, and that conversely where these principles are observed lighter suture material may be used and less tissue included by the stitch with impunity. Deep sutures were first discarded in the smaller lower abdominal wounds, then in the larger lower abdominal wounds, and many surgeons have finally come to discard them even in the case of the upper abdominal wounds, however extensive. Doubtless the time is not far distant when the "tension" suture will cease to be used entirely unless possibly in the extremely obese patient and in the case of carcinomatosis.

a. The proper time for removal: Since the superficial or coaptation suture is merely a skin suture and serves the single purpose of keeping the incised skin edges in accurate apposition it will have ceased to serve its useful function as soon as healing has advanced sufficiently to prevent the skin incision from gaping when the former temporary support has been removed. Just when this time has arrived becomes a matter of judgment, for the rapidity of healing of any skin incision depends upon many factors amongst which are (1) the age of the patient, (2) the general physical condition of the patient, especially the presence or absence of certain organic diseases, such as diabetes, carcinomatosis, and nephritis, (3) the presence or absence of infection, and (s) the amount of blood supply to the part. Obviously skin wounds in young, healthy individuals and wounds which have undergone no suppuration and are not called upon to allow tissue fluid seepage from the deeper parts will heal more readily than the opposite varieties. Furthermore, wounds of the face and scalp, both of which areas have a relatively rich blood supply, can be depended upon to heal much more quickly than, for instance, an incision made in a leg which is the seat of varicose veins.

Accordingly, it will be appreciated that no rules can be made which will apply either to all individuals or to all parts of the body. It is usually considered advisable not to remove skin sutures from abdominal wounds in less than seven days in the case of the average incision which is aseptic and which apparently is healing normally. Undoubtedly there are many instances, the patient being young and robust, in which removal at the end of five days would do no harm, and on the other hand in many or most cases the stitches in such a wound might be left undisturbed for ten or even fifteen days without doing any particular harm. However, the general seven-day time limit for abdominal skin suture removal does not apply to other regions of the body. In some localities, as about the neck and face, especially of women and girls, a minimum of scar formation is a factor of considerable importance; the same

delay in removing stitches from such an incision as from an abdominal one might become a real calamity because of scar formation; such wounds do not usually tend to gape, the blood supply to the part is usually rich, and the early removal of the suture material is followed by no untoward results; often this may be done at the end of forty-eight hours.

The course of events when non-absorbable, or not easily absorbable sutures are left in the skin too long should be borne in mind in cases of doubt; for a certain length of time, unless the formation of a stitch abscess supervenes, sutures introduced into the skin present an unchanged appearance, the points of entrance and emergence of the suture material present the appearance of small puncture wounds which fit snugly about the suture material, and the suture itself hugs the tissue within its bite snugly, but not tightly. As time goes on, however, the first change that is noted, as the result of too great delay, provided that too much tension has not been exerted in tying the suture and undue edema of the part has not caused the suture to begin to "cut out" previously, is a certain looseness which results from a pressure necrosis of the less cellular subcutaneous tissue which has been included in the bite of the suture; the amount of looseness that can develop will, of course, depend upon the amount of subcutaneous tissue included, i.e., in the depth to which the suture needle was originally made to penetrate. The next change that takes place, in the absence of infection, which is, of course, also likely to ensue in cases where removal of sutures is neglected, is a pressure necrosis or ulceration of the skin itself which transforms the original circular punctures through which the needle was originally passed into slits, elongation of which is progressively toward the incision, or, in other words, toward each other; the process terminates when the suture finally cuts through and comes away. This process of ulceration by "cutting through" is accelerated by too tight tying of sutures or by the development of an undue amount of edema. Sutures which have begun this process, either because

they have been left in situ too long or because originally they were improperly inserted or too tightly tied, should be removed as soon as possible, for once this process has originated it

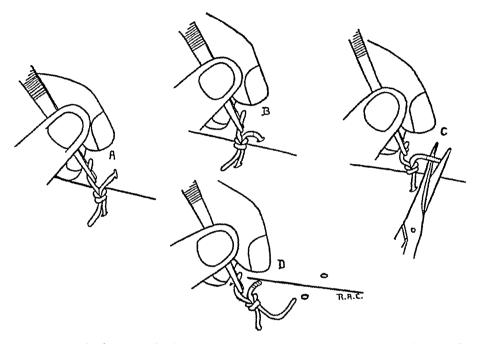


Fig. 51. The four steps in the proper removal of sutures. "A," the suture is grasped with forceps. "B," traction is made with the forceps until a short portion of the suture has been dislodged from below the surface of the skin. "C," the suture is cut in that portion of its length which previously lay below the surface. "D," further traction on the forceps pulls the suture completely away.

tends to progress with some rapidity and it provides an excellent nidus for infection, besides incurring additional scar formation.

b. The technique of removal: Most patients have a real dread of the removal of sutures; this is due partly to an apprehension born of the previous suffering experienced by the patient in connection with the original operative procedure and partly in many instances to the perpetuation of a tradition passed down from the days when untreated silk, linen, and cotton thread were used as suture material; during the process of healing, tissue cells grew into and permeated the interstices

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of these threads and, accordingly, the withdrawal of such material was attended by the disruption of considerable newly formed tissue, a process which was quite painful. Impregnation of silk with paraffin or some other preparation, such as celluloid (Pagenstecher), and the use of other impervious suture materials like silkworm gut as practiced at present makes the removal of sutures a relatively painless procedure, providing only that the surgeon be fairly dextrous in the use of his fingers and gentle in his manipulations.

When the surgeon is ready to remove sutures, the field having ever since the operation been protected from contamination by sterile dressings, there should be no need theoretically for any preliminary sterilization of the involved skin area; practically, however, skin sterilization, even with the most painstaking technique is probably never absolute, and even though it were, bacteria, being ubiquitous, have almost inevitably had ample opportunity to work their way under the dressings. Although not then absolutely necessary, it is usually advisable to swab the suture-line with alcohol or with some other antiseptic solution before attempting the removal of sutures. Sometimes peroxide of hydrogen is an ideal substance to use for this purpose, as the solution bubbles violently when coming in contact with the wound area and this bubbling tends to float away dried secretions which may be present, as well as to soften and render pliable certain suture materials.

The technique of suture removal is simple and can be easily understood from a brief consideration of the illustrations (Fig. 51). The suture is siezed with forceps at or near the knot and gentle traction is made until a quarter of an inch or more of the suture material has been pulled up from below the surface of the skin; to aid in this maneuver gentle counter pressure may be exerted on the skin surface near the point of emergency of the suture. The suture being partly dislodged in this manner, the point of a pair of sterile scissors is slipped under the suture and the latter is cut through in that portion

of its length which formerly lay below the surface; this latter is a portion of the suture certainly sterile, providing the wound itself is sterile. Not too much traction should be made during this manipulation, however, lest some of the suture on the other side of the wound be correspondingly pulled under the surface of the skin. It now remains only to continue to pull with the forceps upon the suture, which now having been cut, pulls away from the other direction completely without, however, drawing under the skin surface in that process any part of the suture that was not previously subcutaneous. This almost completely avoids the possibility of contaminating a previously clean suture track.

Tension sutures may be removed on an average two days later than the coaptation sutures.

In the case of old or debilitated persons, or persons suffering from organic diseases and carcinomatosis, sutures should not be removed from the simpler abdominal wounds earlier than the tenth day unless the sutures are beginning to "cut out," and the tenth-day limit may well be made to apply routinely for certain operations other than abdominal incision, such as perineorrhaphy and hernioplasty even in the robust and healthy.

c. Reinforcement of wounds from which sutures have been removed: If there be any doubt, after the removal of sutures, as to the adequacy of the strength of the operative scar, fairly wide strips of adhesive plaster may be placed across the suture-line in such a way as to splint it. Such splinting of a wound which has been the site of a drainage tube may possibly prevent the development of an embarrassing incisional hernia. If such adhesive bridges be placed across infected wounds they should be changed not less often than every second day.

Not infrequently it becomes undesirable to submit the skin of a patient to the maceration and abuse incident to the stripping away of adhesive plaster as often as may be required by the number of dressings indicated, and it accordingly becomes advisable to devise some means whereby the plaster itself may be left in situ; this is easily accomplished. Strips of adhesive plaster are cut to a convenient length, one end being folded over and a piece of ordinary dressmaker's tape attached thereto; the pieces of adhesive plaster are applied at a slight distance from the margins of the wound opposite each other and the pieces of tape are tied across the wound, thus forming a supportive bridge. The dressing may be changed by simply unfastening the flexible tapes and retying them over the new dressing.

III. CLASSIFICATION OF SURGICAL WOUNDS WITH RESPECT TO STERILITY: INFECTION

Surgical wounds are subdivided into three classes: (1) clean, (2) contaminated, and (3) infected.

Clean wounds are those which contain no pathogenic microorganisms, and all surgical wounds should belong to this class except those which necessarily invade previously infected tissues. Unfortunately, accidental contamination of clean wounds does occasionally occur, and in any case, the contamination of wounds communicating with infected areas is usually unavoidable.

The contaminated wound may be defined as one which contains on its surface pathogenic organisms, which, however, are present merely as foreign bodies, and which do not instigate any detectable defensive reaction on the part of the tissues with which they are in contact. Naturally, such a condition of affairs represents, in the ordinary case, merely a stage in the development of infection, for pathogenic microorganisms usually find on wound surfaces conditions favorable to their rapid multiplication, and such multiplication soon incites a definite reaction on the part of the host.

Infected wounds are those in which the presence of bacteria has called forth a host-invader reaction on the part of the tissues. The reaction is fundamentally inflammatory. Not only do cellular blood elements invade the tissue spaces in the region of the bacteria, but phagocytic leukocytes engulf the bacteria and carry them far and wide into the contiguous tissue spaces.

Accordingly, in the case of infected wounds, not only do the tissues show an inflammatory reaction which they did not show in the case of the contaminated wound, but the bacteria which in the former case lay merely on the surface of the wound, now can be found embedded in the adjacent fixed tissues.

Although it is not, of course, possible to determine in any particular case when a wound has ceased to be merely contaminated and has reached the stage of infection except by biopsy, eight hours are usually set as a somewhat arbitrary boundary between the two conditions. This time interval does not, of course, represent the latent period of the clinical symptom and signs of infection, as infection becomes clinically recognizable only after it has become considerably advanced. Pathogenic microorganisms show considerable variation in the rapidity with which they are capable of establishing tissue reactions.

Anaerobic bacteria are apparently taken up by the tissues more rapidly than aerobic bacteria, and excite defense reactions on the part of the tissues earlier; clinical reactions to anaerobic infection characteristically occur within from seven to eleven hours, whereas such reactions from the aerobic bacteria are delayed till the end of from eighteen to forty-eight hours.⁴

IV. THE TREATMENT OF INFECTED WOUNDS

A. Care of Wounds Infected at the Outset: Obviously the best that can be done for wounds infected at the outset, which have been simply drained at operation, is to prevent further contamination. Such wounds should be dressed and treated according to the principles about to be laid down for secondarily infected wounds. Dressings should be applied to such wounds while they are acutely infected with the same Book Page 464

scrupulous aseptic care and conscience which marks the first dressing in the operating room of a clean abdominal incision.

- B. CARE OF WOUNDS DEVELOPING POSTOPERATIVE SEPSIS: The development of a septic process in connection with incisions into previously non-infected areas should give the surgeon and his assistants well-founded cause for chagrin. Four sources for such infection are obvious:
- (1) Inadequate preoperative sterilization of linen, instruments, and ligatures,
 - (2) Inadequate sterilization of the operative skin area,
 - (3) Faulty operative technique,
 - (4) Postoperative contamination of the wound.

Over all these sources of infection the surgeon exercises, or should exercise, control, and therefore upon him, either directly or indirectly, rests the responsibility for all infections developing in clean surgical cases.

Formerly, the faulty preparation of catgut ligatures was frequently blamed for infections in wounds, but the manufacturers of catgut have now become so meticulous in their methods of sterilization that a surgeon would at present lay himself open to just criticism were he to attribute postoperative infection to this source in the absence of direct laboratory evidence to support his assumption; furthermore, were he to find such evidence he would have no excuse for failing to discontinue his use of catgut from the contaminated source immediately in favor of a new supply of reputable manufacture.

As the well-being of the patient is the only excuse for the existence of the hospital, and as the person directly responsible for the surgical patient's well-being while in the hospital is the surgeon, the activities of all those who serve the surgical patient directly or indirectly should obviously be at all times under the surgeon's closest scrutiny and direction. For this reason, that surgeon must be considered remiss in his duties who does not assure himself, from time to time, that the instruments and other material which he uses, under the assumption that they are sterile, are actually sterile in point of fact, and

weak solutions of phenol produces a hyperemia and edema of the treated part which lead to local necrosis and mummification. Harrington,⁶ three years later, collected from the literature 132 cases of carbolic acid gangrene and described 18 cases of his own. He believed that the danger of such a complication was greater in the case of weak than of strong solutions.

In succeeding years the toxic systemic manifestations of the absorption of phenol came to be recognized with increasing clarity, and in 1919, Le Clerc⁷ described in classical manner not only phenol gangrene, but the generalized symptoms of phenol poisoning, hallucinations, excitement, high fever, and delirium.

Because of these untoward effects of phenol, as well as its damaging action on the kidney during its elimination from the body, no well trained and thoughtful surgeon at the present time would be willing to countenance the continued use of even very dilute solutions of phenol either as a spray wash, or moistening agent in the preparation of wet dressings to be used as more or less permanent applications to infected wounds.

Unfortunately, the fact is not even yet sufficiently appreciated, that carbolic acid is but one of a group of substances classed collectively as phenols all of which show the same, or at least, very similar toxic properties, lysol and cresol, to mention but two representatives of this class of substances.

It may be taken as definitely established that neither phenol nor any of its simpler derivatives should ever be used in any strength whatever as a repeated application to wounds.

Partly as a result of an awakening consciousness of the dangers associated with the use of phenol and partly as a natural expansion of the general principle of antisepsis, a large number of substances possessing antiseptic properties have been developed since the time of Lister as suitable agents for use in infected wounds. Many of these have now been used for so many years that their properties have become "part and parcel" of every medical student's education, and a rehearsal of even the more salient facts known regarding them would not

only consume an undue amount of space but would simply involve a repetition of information easily available in all text-books on materia medica and pharmacology. Amongst the more important of these agents are alcohol, hydrogen peroxide, iodine, the salts of mercury, potassium permanganate, boric acid, picric acid, the mineral acids, the basic hydrates, and various preparations of silver.

In the years preceding the World War these and similar agents of relatively simple chemical composition were widely used in the treatment of sepsis not only in varying strengths and combinations, but also by different methods, i.e., in the form of ointments and salves, soaks, sprays, and compresses. A recital of the methods used and a comparative study of the results obtained would make interesting historical reading, but such a review is largely irrelevant to the present discussion, because the martial crisis of 1914 speedily and unquestionably demonstrated the essential inadequacy of all methods previously developed for the treatment of infected wounds. This may seem, even after the lapse of a number of years since the termination of that struggle, like an offhand way of dismissing the matter, but not only was the pooled knowledge and experience of the surgeons of all armies, representing the best thought and practice of the medical profession, unanimous on that point at the time, but the subsequent development of events has only served to emphasize the truth of the statement. The revolutionary developments in the treatment of sepsis precipitated by the World War and subsequently expanded have been mainly three:

- 1. The elaboration of the Carrel-Dakin treatment,
- 2. The discovery of a number of new, and for the most part chemically complex, antiseptic substances,
- 3. The expansion of an essentially different mode or principle of treatment, not involving attempts at chemical sterilization, which will be discussed presently, and which may be provisionally called "biological antisepsis."

Leaving aside, for the moment, the Carrel-Dakin treatment and "biological antisepsis" to continue with the discussion of antiseptic substances as such, a word must be said concerning the more recent tissue antiseptics. As a result of the general recognition of the inefficiency of the older germicides in tissue antisepsis many new drugs have been developed and exploited during the past decade or more.

b. Hypochlorous acid, Chloramine T, and Dichloramine T: On the one hand, the generally satisfactory results obtained during the war with sodium hypochlorite by the Carrel-Dakin technique served to stimulate investigation of various other chlorine containing compounds in the hope that a more satisfactory chlorine derivative might be found, and on the other hand, various attempts have been made to evolve antiseptics not chemically allied to sodium hypochlorite but possessing its supposedly beneficial characteristics, high toxicity for bacteria and low toxicity for tissue cells.

In addition to Dakin's solution, the tissue antiseptics of the chlorine group which have been found of especial value are (1) hypochlorous acid and its salts, and (2) the closely related compounds, chloramine T (sodium toluene sulphonechloramide) and dichloramine T (toluene sulphonedichloramide).

The preparation of hypochlorous acid which has found the greatest favor is known as "eusol"; it was developed originally by Lorrain Smith and is prepared as follows:

Twelve and a half grams of chlorinated lime are placed in a flask of resistance glass, and to this is added a liter of distilled water. The flask is thoroughly shaken. Twelve and a half grams of boric acid are added, the flask is again thoroughly shaken and subsequently allowed to stand for several hours at room temperature. The contents of the flask are now filtered through cotton wool. The clear liquid thus obtained is the finished product.

Chloramine T is a water-soluble, crystalline drug, and is used most frequently either directly in 2 per cent solution, or in the form of impregnated gauze; this is prepared by immers-Book Page 470

ing the plain, dry gauze in a 5 per cent watery solution of the drug, the gauze being subsequently dried.

Dichloramine T is also a crystalline substance but is almost completely insoluble in water, though rather freely soluble in certain oils. The oils most commonly used are chlorinated eucalyptol and chlorinated paraffin wax; solutions of from 6.5 per cent to 10 per cent are satisfactory. Solutions of dichloramine T are stored in brown glass bottles and are carefully protected against contact with water; solutions which show precipitates (crystalline toluene sulphonamide) are unsuitable for use and should be discarded.

None of these chlorine containing compounds has succeeded in establishing itself in medical favor to the same extent as Dakin's solution, though they are much more stable and consequently, from that point of view, more desirable.

c. The newer antiseptics, Mercurochrome and Hexyl-resorcinol: The other inter-war and post-war antiseptics which have become popular are partly products of the aniline dye industry, and partly substitution products of other compounds used extensively in industrial chemistry. They represent substances of much more complex chemical composition than the antiseptic standbys of the pre-war period. Amongst these antiseptic agents certain ones have found particular favor on the Continent, and certain others have been used more particularly in the United States.

The Continental group includes brilliant green, malachite green, flavine, acriflavine, trypaflavine, and rivanol. The American group includes, along with a number of less well established drugs, mercurochrome and hexylresorcinol.

The relative merits of these antiseptic substances have by no means been settled and their supposed advantages over substances of simpler composition, more modest price, and longer lineage are still open to very serious question. In this country, of course, a discussion of these newer antiseptics centers chiefly about mercurochrome and hexylresorcinol.

Mercurochrome: Mercurochrome was introduced into medicine and popularized largely through the influence of Hugh Young.8 Originally used more particularly as an antiseptic in genitourinary practice, this interesting, brilliant red substance has been employed not only on mucous membranes of other parts of the body, but has been introduced directly into the blood stream in the treatment of septicemia, and has been used more or less widely as a general skin disinfectant; it has been employed both in simple watery solution and suitably reinforced with acetone and alcohol. Opinions as to its value in the treatment of sepsis differ considerably; Sanner and Hill9 have recently presented experimental evidence to show that it is of value in the treatment of local infections; Wright¹⁰ finds it effective in the destruction of the Staphylococcus aureus but of no value in the destruction of Bacillus pyocyaneus; and Rodriguez¹¹ believes that it is quite inefficient when in 2 per cent aqueous solution, and unsatisfactory even in 5 per cent solution in alcohol and acetone.

Hexylresorcinol: Hexylresorcinol is an alkyl resorcinol, and accordingly a derivative of phenol; the biological properties of the class of substances to which it belongs were originally outlined by Veader Leonard, 12.13 and this particular member of the series has been popularized by Leonard and his associates. Leonard and Feirer¹⁴ recommend for general antiseptic purposes a solution containing 30 per cent glycerine and 70 per cent water in which is dissolved 1 mg. of crystalline hexylresorcinol per cubic centimeter; such a solution possesses a surface tension of 37 dynes per centimeter and is therefore known as "s.r. 37." These authors find 15 that in the guinea pig, wounds artificially inoculated with Staphylococcus aureus, Streptococcus viridans, Streptococcus hemolyticus, and Bacillus coli are invariably sterilized by "s.T. 37" within one minute. Allen and Wright 16 however, have investigated the bactericidal properties of "s.r. 37" and draw quite different conclusions. They find that it is not effectively bactericidal for Bacillus pyocyaneus in forty-eight hours, but that it is bactericidal for Staphylococ-

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cus aureus in something less than ninety minutes, and destroys Streptococcus hemolyticus in fifteen minutes or less.

The foregoing discussion of antiseptics is offered merely as a sketchy and abbreviated account to serve as an introduction to a consideration of the general place of antiseptics in the treatment of infected wounds.

d. General evaluation of the method of antisepsis: The very number and variety of the antiseptic substances previously considered should offer convincing evidence of the general unsatisfactoriness of antisepsis as a method. The ideal antiseptic has eluded the search of the medical profession like the proverbial "will-o-the-wisp," and by and large, each new substance, though hailed with high hopes at the outset has been finally forced, or is by way of being forced, into virtually the same measure of disfavor as its predecessors. That the shortcomings of these substances are not due to their inability to destroy micro-örganisms as such is very obvious, for with but few exception, all of them show very marked and satisfactory germicidal powers outside the body. The satisfactory sterilization of unbroken skin is rather readily accomplished by some of them. When the skin is broken, on the other hand, and the tissues become infected, a situation is created which is intrinsically different.

Were the bacteria in an infected wound confined to the cavity of the wound or even the superficial layer of tissue lining the sides thereof, the application of a suitable antiseptic to the wound cavity might well succeed, in certain cases at least, in destroying all the bacteria present and in thus sterilizing the wound completely. This is, of course, one's object in pouring strong antiseptics into freshly made contaminated wounds which for one reason or another cannot be thoroughly debrided, and such treatment, though not always effectual, is at least not irrational.

In infected wounds not less than three considerations combine to annul any good effects which bactericidal drugs might otherwise have.

- (1) In such wounds the bacteria have already invaded the fixed tissues adjacent to the wound edges, having been phagocytized by the actively motile leucocytic cells, and in many cases have been transported far and wide into the regional tissue spaces and lymphatics; during this process many of the microorganisms, not overcome by the body defensive mechanisms, have undergone extensive multiplication. The application of an antiseptic to such a wound cannot be effective because no known antiseptic possesses the property of penetrating tissues to anything like the extent represented by the dissemination of the microorganisms. As a matter of fact, almost all of the common antiseptics have very little penetrating powers at all.
- (2) In the case of infected wounds bactericides are required to act not in a watery medium, in which they are characteristically most potent, but in a complex medium, serous, frankly purulent, or even bloody, in which their potency is invariably much diminished. In the case of some of the antiseptics the mechanisms by which their efficiency is diminished in such media is obvious. Many of them depend for their bactericidal action upon their ability to coagulate protein, and when brought into contact with albuminous material immediately defeat their own purposes by building up an impervious restraining wall of coagulum against their own further activity.

In the case of certain stains, particularly the members of the aniline dye group, their bactericidal powers are apparently indissolubly connected with their ability to stain protoplasm, and as Fleming¹⁷ has observed, in a watery solution of bacteria, the bacteria contain all the protoplasm present, so that a maximum staining effect is obtained in such a case, whereas in wounds, leucocytes and fixed tissue cells dissipate the action of the antiseptic by themselves absorbing a considerable part of the stain, thus leaving a much attenuated medium to act upon the bacteria.

(3) Not only do bacteria suffer from the effects of antiseptics when these substances are introduced into wounds, but the

fixed tissue cells and the leucocytes are also destroyed to a greater or lesser extent. In spite of the many attempts which have been made to develop or discover an antiseptic with differential toxicity for bacteria, no convincing evidence has been presented to show that such an end has even been accomplished, or, indeed, that it can be accomplished. Moreover, as the healing process depends ultimately upon the activity of the body tissues, the application of antiseptics to wounds interferes directly with the healing process and so tends to defeat its own aims.

Accordingly, the wise surgeon has now learned to look with suspicion on the entire host of antiseptics when he is confronted with the treatment of an infected wound, because he has discovered that when he is fighting infection he is fighting living organisms which are cells not dissimilar to those of which the body of the host is composed and which are vulnerable even to a less extent in many cases than the body cells themselves, particularly the leucocytes of the blood which are the surgeon's most powerful allies. Only the unwary then are deluded by bright colors, new names, exorbitant prices, and splurges of printers' ink into thinking that every newcomer to the field of antiseptics has finally solved the problem of killing the one without at the same time maining the other.

2. The Carrel-Dakin Technique: The Carrel-Dakin treatment of infected wounds must be considered separately from the general discussion of antiseptics.

In the first place, this form of treatment deserves the utmost respect, because of its proved efficiency in the treatment of the alarming sepsis of war-time surgery, and, therefore, even if regarded as a method primarily involving the principle of antiseptics, should, nevertheless, be considered as preeminently superior to all other methods involving the same principle, and for this reason, entitled to especial consideration.

In the second place, however, the antiseptic used in this form of treatment is inefficient except when used according to a certain definite technique and, therefore, constitutes a notable exception to other antiseptics as a class; the question consequently arises as to whether the antiseptic as such or the method of application is fundamentally responsible for the value of the method.

In the third place, the Carrel-Dakin technique exerts on infected wounds a cleansing action not seen when other antiseptics are used; the particular antiseptic solution shows a marked proteolytic action in accordance with which sloughing tissues are removed and the wound surface is kept mechanically clean; the importance of proteolysis as an adjunct to the treatment of sepsis comes therefore in question.

The Carrel-Dakin treatment of infected wounds is a treatment in which a 0.45 to 0.5 per cent solution of sodium hypochlorite, devised by Dakin, is applied to the surfaces of infected wounds by means of a mechanical distributing system developed by Carrel. The combined technique was painstakingly elaborated especially for the exigencies of military service and was of inestimable value in the treatment of war wounds. This form of treatment has been found particularly applicable to the severest types of infections, both military and civil, especially to those which are amenable to no other form of therapy, but it can be used to equally good, or even better, advantage in those infected wounds often regarded as of minor significance and commonly treated by other means. Against the Carrel-Dakin therapy there is still little to be said except from the point of view of expediency. Time has sufficiently demonstrated that only those individuals fail in the use of the method who modify it, i.e., who substitute here or there modifications of their own for the details of the established technique. The matter of expediency, however, is not to be lightly dismissed as the technique is rather exacting, and, in order to follow it adequately it is necessary (1) to have access to a supply of freshly and accurately prepared solution,

(2) to have a means of obtaining frequent and accurate bacterial examinations, (3) and to be able to command full cooperation both day and night of an especially trained nursing staff, facilities which are, it may be said only rarely available in the average civil surgical practice.

Dakin's solution is prepared and standardized chemically once every twenty-four hours in such a way that its percentage strength is within the limits indicated previously; if used stronger than this it becomes irritating and destructive, if used weaker, it is of little or no value as a sterilizing agent. Solutions rapidly lose their titer on standing and become ineffectual. It is for this reason that insistence is placed on accuracy and freshness of preparation.

Upon the bacterial count of smears from wounds depends one's ability to gauge the measure of success of the treatment, to handle the mechanical adjustment of apparatus with intelligence, and to determine the opportune time for subsequent wound closure. Without this the method of necessity becomes a haphazard affair.

As mechanical maneuvers subsequently to be described must be performed at frequent intervals and without intermission, and as the surgeon himself cannot be constantly at the side of the patient, dependability, intelligence, and experience with the method on the part of the nursing attendant are an added necessity.

- a. The Carrel distributing apparatus: The Carrel distributing apparatuus consists of three fundamental parts:
- (1) The reservoir for containing a supply of the irrigating fluid.
- (2) A rubber connecting tube which is provided with a pinchcock and which serves to conduct and regulate the flow of fluid from the reservoir to the next or third part of the apparatus,
- (3) A branching system of tubes partly of glass and partly of rubber which serves to bring the fluid into direct and intimate contact with the wound surface to be sterilized.

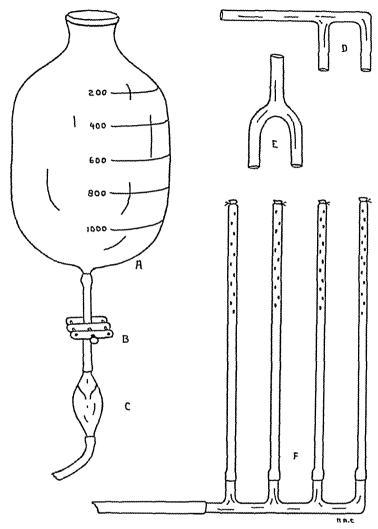


Fig. 52. Essential features of Carrel technique for use of Dakin's solution. "A" represents a bottle or container which acts as a reservoir; this container is best made of amber colored glass in order to minimize disintegration of contained solution by actinic light rays. "B" is a screw-clamp which is best not allowed to remain open continuously, as in the "drip" methods, but remains closed most of the time and is opened more or less widely for a few moments only at intervals for the production of "tidal irrigations." "C" is a dropping tube which functions as a means of visualizing the approximate amount of solution released when "B" is opened. "D" and "E" are two different types of glass delivery tubes. "F" is a four-armed delivery tube which has been fitted with rubber distributing tubes; these rubber tubes are perforated along the sides with many small holes and at the ends are tied tightly with pieces of cord; this part of the apparatus is ready for insertion into an infected wound.

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The reservoir is of glass, usually amber colored to minimize disintegration of the contained solution by actinic light rays, and is conveniently of a capacity of 500 to 1000 c.c.; it is suspended at a height of 2 to 3 ft. above the wound to be irrigated, being attached to any convenient support, an adjustable irrigating stand being often desirable, but by no means necessary for the purpose.

The rubber connecting tube is of a length of a couple of yards and has a lumen about 7 mm. in diameter; it is always provided with a pinchcock to regulate the rate of delivery of solution and it may or may not contain interpolated in its length below the pinchcock a glass dropping tube.

At the end of the rubber connecting tube is a glass tube which may be simple and straight, or which may contain from one to many side tubes depending upon the size of the wound to be irrigated and the number of terminals necessary for the purpose. Each one of the glass side tubes is provided with a length of rubber tubing which forms the most terminal part of the irrigating system, i.e., which establishes contact with the tissues. These latter rubber tubes are of varying lengths depending upon the size and shape of the wound in connection with which they are to be used; they have a lumen of about 4 mm. in diameter and are relatively thin walled; they are usually tied tightly at the end and perforated along the sides. The perforated part of these tubes may or may not be covered with turkish towelling stitched in place to distribute the fluid more evenly to the surfaces of the wound, but this covering of the tubes is not advised in the latest descriptions of the technique as given by its promulgators (Fig. 52).

b. Preliminary preparation of the wound for Dakinization: Preliminary preparation of the wound consists primarily in securing free access to any angulations and pockets that may be present in the wound and the surgical removal of debris in order that the antiseptic fluid to be subsequently used may have free access to all parts of the infected area, and may come into more or less direct contact with viable tissue. The area

around the infected wound being prepared as for any other surgical operation and having been painted with benzine followed by iodine, devitalized tissue is freely trimmed away, necrotic tissue is removed, and foreign bodies if present are dislodged and evacuated; added incisions may also be necessary in order to provide access to partly closed pockets. If at all possible, in doing this the fingers should never be used directly in the wound, but the various manipulations should be performed solely by the intermediation of instruments. Cultures should be taken at this time, if such has not already been done, these to be examined subsequently for purposes of identifying the organisms present and for estimating the approximate number of such organisms.

c. The placing of the distributing tubes of the irrigating apparatus: The wound is now ready for the placing of tubes; some planning is usually necessary in this part of the prodecure to ensure that the liquid may come into intimate contact with every remotest corner and diverticulum involved in the infective process. No specific directions can, of course, be given as to how this can be done most effectively; every case is a problem in itself because no two wounds are ever of identically the same shape and size. If the operator has fair mechanical sense, however, and if it be remembered that the problem is purely one of hydrostatics, the course of liquid under pressure, it should in the average case be a matter of no especial difficulty to insure free circulation throughout the entire infected area. This is the essential feature of the treatment, and unless such a result be obtained the best end-results can scarcely be expected.

The tubes having been arranged, attention is directed to the dressing of the wound. This is effected by means of gauze compresses dipped in Dakin's solution and placed in position with dressing forceps, the fingers in this case, as before, not coming into contact with the wound surface if at all possible. The healthy margins of the skin should be protected from the direct action of the solution by vaseline, for Dakin's solution

is irritating to the skin. Much can be done while placing the compresses to assure an equal distribution of the solution by building up one part of the dressing to act as a dam against excessive overflow and loose packing of another area to assure the attraction of fluid to such a part by capillarity.

The finished dressing should be fairly voluminous and should be built up about the tubes; it should be held in place by bandages in locations where these can be used to advantage; otherwise, strips of adhesive plaster are used. The tubes may be pinned to the finished dressing in order that such movements as the patient makes may not dislodge them.

d. Subsequent care of the apparatus: Irrigation: Formerly it was the custom to employ a continuous irrigation technique, the rate of flow being adjusted so that in the average case 5 to 20 drops of the solution were delivered to the distributing system every minute. At present it is considered better to open the pinchcock from the supply reservoir only at intervals of about two hours allowing enough fluid to escape into the distributing system each time this is done to resaturate the dressings. In the average case the amount will vary between 10 and 15 c.c. and the time consumed in this process, from one to three seconds. This must be done with religious regularity day and night. It is essential, furthermore, to see that the permeability of the tubes is assured at all times.

Redressing: Once during the course of each twenty-four hours the wound is uncovered, inspected, and redressed with fresh gauze compresses. The time for doing this should be so chosen that two hours will have elapsed since the last irrigation, because during the course of the dressing bacterial smears are always taken for subsequent examination, and it is desirable that these be taken at as unfavorable time as possible in order that the attendant be not misled as to the effectiveness of the treatment, which in turn might lead to its too early discontinuance. No hesitation should be felt in readjusting tubes or rearranging the distribution of compresses during the course of any dressing in order to correct faulty distribution of the

fluid, providing the fingers be not placed in the wound and an otherwise rigidly aseptic technique be observed.

e. Bacterial smears: Bacterial smears not only give information as to the kind of organisms present in the wound, but also as to the progress of the infection, or, in other words, the effectiveness of the treatment. If the number of organisms found on examining a smear be greater than on previous occasions, obviously the battle is with the invaders, and unusual care should be used at the next dressing to search for the cause and, if possible, to remedy the condition. If, however, daily counts show a steadily decreasing number of organisms the treatment is obviously succeeding, and there is no particular indication for greater care than previously used or change of regime. When on 3 successive examinations at intervals of twenty-four hours, only 1 coccus or a pair of diplococci are found to 4 or 5 high-power fields of the microscope the wound is considered sterile and may be sutured in the same manner as any surgically sterile wound.

In some of the base hospitals toward the close of the World War it was customary to require 3 successive negative smears, the last being controlled by culture, before secondary suture was permitted.

Badly infected wounds required about seventeen days for sterilization by the Carrel-Dakin method.

A consideration of the several factors concerned in the proper performance of the Carrel-Dakin technique, none of which may be slighted if the method is to succeed, very strongly suggests that the principles of antisepsis play but a minor rôle in this particular form of treatment. The fact that too strong solutions of sodium hypochlorite act as irritants and interfere with healing is not without significance, for all other antiseptics can be used more or less indifferently in various strengths, and if Dakin's solution depended for its action on its antiseptic powers slight variations in percentage composition should not make so marked a difference in results. Similarly, in considering too weak solutions of hypochlorite of soda, some antiseptic

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effect should be expected, provided this were the principle primarily responsible for the value of the method, even though the strength of the solution were not exactly maintained; such, however, is not the case, and wounds treated with solutions even slightly below titer rapidly become foul and covered with sloughs.

Although not yet definitely proved, it seems very likely that a large part, if not all, of the effectiveness of the Carrel-Dakin technique depends upon certain principles immediately to be discussed in connection with "biological antisepsis," and if so, the action of Dakin's solution is not primarily disinfectant.

3. Biological Antisepsis: Biological antisepsis presupposes the impossibility of sterilizing a wound by the use of chemical antiseptics and depends entirely upon aiding the physiological or biological agencies which make for natural recovery. As will readily be appreciated, such a program is ambitious, to say the least, and when one stops to consider that only since the World War has this conception gained any degree of favor, one need not be surprised to find that the principles of treatment which have thus far crystallized are relatively embryonic.

Biological antisepsis, however, both theoretically and practically presents such obvious advantages over other methods of treating sepsis that one is probably well within the bounds of truth in stating that not only has greater progress been made in the treatment of infected wounds during the past fifteen years than in all the centuries preceding, but also that all future progress must be based upon biological or physiological methods. To Sir Almroth Wright and his followers we are largely indebted for the progress thus far made.

a. The importance of free drainage and macroscopical cleanliness in the treatment of infected wounds: Although the importance of free drainage in connection with infected wounds has been taught to some extent for centuries and the value of primary surgical removal of devitalized tissue, foreign bodies, and disintegrating blood-clot, has been more recently estab-

lished, particularly as a result of war-time experience, the rationale of these therapeutic measures is probably not generally appreciated by surgeons. Sir Almroth Wright and his followers have contributed a concept of importance in helping to understand the value of such procedures which, if more generally known, would probably go a long way toward impressing upon the mind of the surgeon the great importance of macroscopical cleanliness as a primary prerequisite in the treatment of all superficial infections.

Normal human plasma, serum, and lymph possess very marked bacteriostatic powers. About the only organisms which will grow in such fluids when inoculated in reasonable numbers, are the streptococci and to a limited extent the staphylococci, and certain diphtheroid organisms. In individuals suffering from severe septic infections the bacteriostatic power of the body fluids is greatly enhanced, and even the organisms mentioned here when coming in contact with such fluids under ordinary cultural conditions grow very sparsely or not at all. Apparently a large part of this bacteriostatic power is due to the presence in the body fluids of antitryptic substances, for when trypsin is added to such fluids they lose their bacteriostatic powers, and this in direct proportion to the amount of trypsin added.

In septic wounds tryptic ferments arise from the disintegration of tissue cells, especially from the disintegration of leucocytes. When such disintegration of tissue cells is maximal, as in the presence of gross sloughs, the antitryptic power of tissue fluids poured into such wounds is minimized or annulled, the antitryptic bodies being neutralized by the tryptic bodies of tissue disintegration.

The presence in an infected wound of gross masses of disintegrating tissue or fluids containing numbers of dead and dying leucocytes is thus seen to offer a most effective hindrance to wound sterilization. Accordingly, the first surgical duty which the medical attendant is called upon to perform when confronted with an infected wound is the establishment of a

condition of gross or macroscopical cleanliness. Not only must the wound be laid wide open, all pockets and diverticula being freely explored, but devitalized tissue must be gently and carefully removed with knife or scissors, so that the wound presents neither pools of purulent material nor sloughs.

b. The use of hypertonic salt solutions: Although the mechanical removal of sloughs and grossly contaminated material from septic wounds enormously conserves the antitryptic powers of the tissue fluids poured into the infected area and thus tends to favor the rapid control of the local multiplication of bacteria, no merely mechanical method can, of course, completely remove all decomposing material from the average infected wound, nor can it prevent continued decomposition of tissues as the result of the further action of bacteria necessarily left behind. The good effect of primary mechanical cleansing of infected wounds does not endure, therefore, unless some added mechanism can be provided to maintain the condition of cleanliness originally instituted. The physiological process by which the mechanical cleanliness of infected wounds tends to be maintained is one of tryptic digestion; the cells undergoing disintegration in the infected area themselves liberate a tryptic ferment which under favorable circumstances is capable of liquefying necrotic tissue and which in this manner favors continuous wound cleansing provided only that the position and other circumstances of the infected area are such as to facilitate drainage of the resultant liquefied material.

As will be appreciated from these considerations, the action of natural tryptic ferments in infected wounds is partly beneficent and partly malevolent, beneficent insofar as the removal of cellular debris is concerned, malevolent insofar as the neutralization of the antitryptic powers of the various tissue fluids is involved.

Any attempt to manipulate the process of tryptic digestion in infected wounds therapeutically must therefore resolve itself into a compromise; sufficient tryptic digestion must be allowed to occur so that cellular debris is adequately liquefied and eliminated, and, on the other hand, the local concentration of tryptic ferments must not be allowed to become so great as to overcome the natural antitryptic power of the tissue fluids and thus facilitate further suppuration. Very possibly there may subsequently be discovered some more satisfactory method of achieving this end than is at present known, but for the time being, the expedient which seems to be of most value involves the principle of alternation; conditions are alternately produced which favor now tryptic digestion and now antitryptic action.

In order to understand the method usually employed in establishing this alternation, it is necessary to understand that of all the cells liberating tryptic ferments into infected wounds the leucocytes are the most important. Any substance or agency which destroys leucocytes will liberate relatively large amounts of tryptic ferments. The destruction of leucocytes is apparently the primary function subserved by Dakin's solution in the Carrel-Dakin technique. It will be remembered in this connection that according to the later experience with the Carrel-Dakin technique continuous irrigation of wounds was not nearly so satisfactory as intermittent irrigation, and this coincides very well with the theoretical considerations involved in the principle of alternating tryptic and antitryptic action now under discussion.

Certain hypertonic salt solutions are also capable of destroying leucocytes, such as relatively concentrated solutions of sodium chloride and magnesium sulphate. These solutions when applied to infected wounds immediately cause the disintegration of leucocytes and the consequent liberation of tryptic ferments. The salts have no antitryptic powers themselves, so that the liberated trypsin is at once free to act on any cellular debris that may be present. The action of hypertonic salt solutions as thus used is not ordinarily continuous because such solutions very speedily become diluted with wound secretions and when thus sufficiently diluted are no longer capable of causing further disintegration

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of leucocytic cells. In the repeated application of moderate quantities of hypertonic salt solutions to infected wounds is thus seen a very efficient method alternating conditions favorable now for tryptic digestion and now for antitryptic action.

Hypertonic salt solutions are of value in the treatment of sepsis, however, not only because of their moderate destructive action on leucocytes, but because of a possibly more fundamental action which depends upon osmotic tension.

The septic process which takes place in the cavity of an infected wound constitutes but part of the total phenomenon of suppuration; in the depths of the tissue contiguous to any infected wound is concomitantly occurring a process of leucocytic disintegration; here degenerating cells are liberating trypsin directly into the tissue spaces thus corrupting the contained lymph, upon the antitryptic and antibacterial powers of which control of infection in the tissue itself depends. Hypertonic salt solutions are capable of withdrawing such contaminated lymph from the environs of the wound and of thus producing a process amounting to an internal lavage of the contiguous tissue. The value of the removal of this contaminated lymph from the tissue spaces and its subsequent replacement by fluid of full antitryptic and antibacterial potency derived from the blood stream can hardly be overestimated.

With regard to the question of the best hypertonic salt solution to use for the purpose described there is no very definite concensus of opinion at present. Wright has recommended a solution consisting of sodium citrate 11 grains and sodium chloride 20 grains to the ounce of distilled water, but there is no evidence as yet available to prove that a combination of salts acts more efficiently than a single one. Ordinary salt, or sodium chloride, is efficient in 5 to 10 per cent solution and presents the obvious advantage over many other substances that it is very cheap and readily obtainable. About the only objection to sodium chloride arises from its irritating properties.

Hypertonic sodium chloride solution is, of course, nothing more or less than "brine," and the discomfort produced by the entrance of brine into an open wound is a matter of everyday experience; however, the solutions of salt customarily used are not strong, and the irritating properties of the solution are accordingly minimal.

Solutions of magnesium sulphate also of 5 to 10 per cent strength present the advantages of economy and availability possessed by sodium chloride and in addition, instead of being, like ordinary salt solution, irritating to exposed nerve ends are actually analgesic. For this reason hypertonic solutions of magnesium sulphate are more grateful particularly to the apprehensive and hypersensitive patient.

Von Gaza¹⁸ contends that the hypertonicity of salt solutions when used in the treatment of infected wounds is not the only factor to be considered, for he has found that though sodium chloride increases the size of granulations in healing wounds the opposite effect is produced by calcium chloride solutions. He therefore concludes that some of the effect produced by these solutions is dependent upon ionization of the wound, and in accordance with his experimental findings he advocates the use of sodium salts in those wounds in which considerable tissue defects require to be filled, whereas in cases in which epitheliazation alone is desired calcium salts are indicated; the evidence presented is, however, not entirely convincing. Until more detailed knowledge of the action of various ions has been developed the question of the particular salt to be used may well be left open, and until further evidence becomes available sodium chloride and magnesium sulphate may be regarded as presenting the necessary characteristics.

c. The agency of absorptive dressings: Up to the present no mention has been made of the bactericidal properties of the leucocytes as such. The leucocytes, as is well known, and as recently emphasized by Wright¹⁹ possess the power not only of excreting, under appropriate stimulation, bactericidal substances designed to destroy bacteria directly, but also the

power of engulfing bacteria and destroying them by a process of intracellular digestion. The action of the leucocytes is thus partly dependent upon their chemical properties and partly upon their power of ameboid movement. Wright believes that the polymorphonuclear cells are able to make their way faster through the walls of capillary blood vessels than the mononuclear cells because of the peculiar irregular shape of their nuclei; by a twisting and turning motion the polymorphonuclear cell wriggles its way through an opening which would more easily restrain a cell with a regularly rounded nucleus. At all events the polymorphonuclear cell finds its way to any seat of bacterial multiplication in the body with remarkable rapidity, and microscopical examination of any grossly infected area invariably shows masses of these cells engaged in active combat with invading microorganisms.

Two essential conditions seem to be necessary in order that the bactericidal activity of the leucocyte may be exerted maximally: (1) the supply of leucocytes must be continually augmented, and (2) each leucocyte must have some definite point of attachment.

If the pus from a closed lesion, such as a furuncle, be examined microscopically it will be seen to contain leucocytes which show little motility or none at all, and if the bactericidal properties of these leucocytes be tested culturally they will be found to be very feeble indeed. The situation is comparable to that of a human battlefield in which no provision has been made to supply reinforcements; the leucocytes typify the defending force which by dint of long fighting has been partly killed, partly maimed and partly disabled by exhaustion. If, on the other hand, an actively healing acute ulcer be examined microscopically, the leucocytes will be found to be actively motile and exceedingly bactericidal in culture. In this case, to use the same simile as before, the dead and wounded soldiers have been removed as fast as they have fallen and new recruits have been inducted into their places. Dressings, because of their absorptive characteristics, play a very important part in the removal of such pus as is characterized by the presence of dead and therefore useless leucocytes; in removing this pus an opportunity is afforded for more leucocytes to be mobilized. The actual mobilization of these leucocytes is, of course, facilitated by the action of hypertonic solutions.

The removal of secretions from wounds by the agency of suitable dressings is of value also in providing points of attachment for the leucocytes and thus aiding them in their phagocytic activities. An emulsion of leucocytes swimming free presents relatively feeble bactericidal powers compared with the bactericidal powers possessed by the same number of leucocytes attached to a surface. The situation is as if the invading bacteria and the defending leucocytes were engaged in a tug-of-war and the sides of the wound and the meshes of wound dressings were capable of acting as a fixed support to which the leucocytes could attach themselves to gain an advantage.

d. The action of heat: The action of heat in hastening chemical reactions is almost axiomatic, and inasmuch as a considerable part of the control of any infectious process depends in the last analysis upon chemical reactions, the favorable influence of heat on infectious processes should be considereable.

Ebeling²⁰ some years ago showed this effect very interestingly when working with alligators. He found that an increase of 10°c. in the temperature of a wounded area actually doubled its rate of healing.

In addition, however, to the influence of increases in temperature on chemical activity, the physiological action of heat in the production of arterial hyperemia and local dilatation of arterioles and venules must not be forgotten. In order for the concentration of leucocytes in a given infected area to be maximal a very rich arterial blood supply to the part must be provided.

- e. The action of rest: The value of rest both local and general in the treatment of any inflammatory process is universally accepted and the importance of this factor need not be particularly dwelt upon. Generalized rest is, of course, provided in connection with infected wounds in the confinement of patients to their beds, and localized rest may be enforced occasionally by splinting.
- f. The actual treatment of infected wounds according to the principles of biological antisepsis: Assuming that in any actual case of sepsis the age-old principle of the establishment of drainage has been amply respected and that in suitable cases the macroscopic cleansing and "freshening" of wound edges have been accomplished, the practical application of previously considered theoretical principles of biological antisepsis immediately comes in question.

Rest: The condition of surgical patients quite apart from the presence of any localized suppurative process characteristically serves as an indication for the enforcement of generalized rest of the body in bed. However, in the exceptional case in which sepsis develops in ambulatory cases the patient should be promptly ordered to bed so as to favor conservation of any reserve energy of the body for purposes of combating the infectious process.

Local rest of the infected part of the body may or may not be adequately secured concomitantly with the establishment of recumbency in bed. In the case of infected abdominal and thoracic incisions this will, of course, usually be the case. In the case of infections of the neck, head, and extremities some further immobilization is not infrequently necessary or desirable. Local immobilization may be adequately arranged in most of these latter cases by the use of sandbags or pillows so arranged about the affected part as to prevent lateral motion. In rare cases the actual application of an immobilizing splint may be not only feasible but desirable.

The use of hypertonic solutions: As has been previously mentioned, other characteristics beside hypertonicity may be

partly responsible for the good effects produced by the use of hypertonic solutions in the treatment of infections, but in the absence of further and more convincing evidence than is at hand, one is hardly in a position to dogmatize on this matter with too much assurance. It may be provisionally assumed that of two solutions of the same hypertonicity, that one is preferable for use in the treatment of infections which presents the more desirable additional, accidental, or concomitant properties. No one should be misled, however, when using hypertonic solutions for the purpose under discussion into thinking that an additional bactericidal property is to be desired in connection with the solution; such a fallacy has evidently been in the minds of certain authorities who particularly advocate the use of boric acid. Boric acid has sometimes been regarded as a mild antiseptic, it is true, but such bactericidal properties as it may possess are very feeble indeed, even in a watery medium, and must be quite negligible in an infected wound. Aside from this, however, and more fundamentally, no one should be deceived into thinking that in the use of boric acid, or any other substance supposed to possess bactericidal properties in addition to its properties of hypertonicity, one is guided by rational considerations, for if the principle of antisepsis is irrational when considered on its own merits it is no less irrational when combined with any other principle, whether the latter be itself sound or not. Bactericidal properties as such are not desirable in connection with hypertonic solutions used for the treatment of infected wounds.

Incidentally, boric acid has one essential property which is almost certainly not desirable, it is only sparingly soluble. The solubility is from 4 to 5 per cent, and thus a saturated solution is either just at or even somewhat below the lowest value usually regarded as efficient for solutions to be used on infected wounds. Solutions of from 5 to 10 per cent are usually recommended.

In passing, and while on the subject of boric acid, it may be worth while to note that there has been some experimental evidence tending to show that a localized acidosis may accompany the process of repair in infected wounds. If the healing process can be definitely shown to be characterized by regional acidosis, rational therapy in the future may take this factor into account and boric acid, or some other weak acid, because of its acidity, may be generally recognized to have an advantage greater than at present supposed.

For the time being, however, attempts to elaborate practical methods based upon a more or less speculative regional acidosis should not be accepted too enthusiastically, much less attempts to establish generalized acidosis by manipulation of the diet.

Furthermore, there is a little evidence to show that alkalinity may occasionally be more desirable than acidity. Sir Almroth Wright²¹ has shown that Welch's bacilli at least grow only with great difficulty in unaltered blood serum; such serum has about the same alkalinity as a ½5 normal alkali. If, however, this alkalinity be partly or completely neutralized, these particular organisms grow luxuriantly.

In the absence of further studies, all otherwise applicable hypertonic solutions of a given strength may be considered equally efficacious, and there therefore seems to be no advantage in using more expensive, complex, or less available solutions than sodium chloride or magnesium sulphate. As mentioned in the preceding theoretical discussion, there is no incontrovertible evidence that combinations of salts have advantages over a single salt in simple solution. The advantages of magnesium sulphate over ordinary salt solution have been mentioned, and this is probably the salt most commonly desirable.

In order to prepare or intelligently to order the preparation of solutions for purposes such as the one under discussion, it is frequently desirable to have some "rule of thumb" by which a satisfactory solution may be improvised even in the absence of access to really accurate weights and measures. Some method of preparation which can be employed by the nurse in the absence of technical laboratory facilities is of value. An ordinary heaping tablespoonful of magnesium sulphate weighs about 16 gm.; an ordinary heaping tablespoonful of sodium chloride weighs about 30 gm. For practical purposes these values may be taken as approximately ½ oz. and 1 oz. respectively. As there are 32 oz. in the American quart, 4 heaping tablespoonfuls of magnesium sulphate or 2 heaping tablespoonfuls of sodium chloride when dissolved in 1 qt. of water will make approximately a 6 per cent solution. These amounts can be conveniently modified, of course, to give stronger solutions, on the one hand, or if occasionally so desired, weaker ones on the other; but the percentage of solutions to be used in the treatment of infection is not critical.

Possibly some such method as that used to deliver Dakin's solution to wounds, as described in connection with the Carrel-Dakin technique, might work very well as a method of application for hypertonic solutions, but such technique would be unnecessarily cumbersome for the smaller and simpler infections, and in the severest types of infections the Carrel-Dakin technique entire is probably still the method of choice.

Two simple alternatives are very obvious: either the infected wound may be dipped into the solution, or the solution may be placed upon the wound. The first method, or the method of immersion, is readily applicable only to certain limited portions of the body, especially to the hands and forearms, feet and legs. In order to immerse wounds involving most other parts of the body, not only would inordinately large amounts of solution be required, but in the case of acute infections two other factors would tend to militate against success: (1) the necessity of moving the patient's body about, and (2) the danger of further contamination of the infected wound neident to immersing actually infected and potentially infected body areas together in the same bath.

In the case of infected wounds of the extremities the method of immersion or soaking may frequently be used very success-

fully; the solution into which the extremity is to be placed should, of course, be sterile. This condition of affairs may be insured either by using a previously sterilized container and solution or, more simply, by boiling the solution to be used in the container to be used. The unbroken skin of the extremity to be placed in the hypertonic solution should preferably be bacteriologically clean, especially in the case of acute infections; frequently this state of affairs will have been established either in connection with a previous operation or in connection with the preliminary mechanical cleansing of the infected area several times previously mentioned as essential. Any sterile gauze dressing that may have been placed about the affected area may and should be left upon the extremity during the process of soaking providing it be of such character and applied in such a way that it is readily permeable to its innermost recesses by the solution and providing further that it be not initially grossly soiled with wound secretions. The part played by gauze coverings in the control of infection is not only protective, but actually intrinsic, as mentioned in the preceding theoretical discussion, because, on the one hand, the meshes of the gauze exert capillary attraction for relatively inert pus, and on the other, serve as a meshwork support or trellis to which actively bactericidal leucocytes may attach themselves for support and from which they may launch an advantageous attack upon the invading bacteria.

In the use of the immersion method due attention should be paid to the principle of alternation of tryptic-antitryptic action in the wound. Periods of soaking should be alternated with periods of removal of the infected wound from the bath and rest. A two-hour period of intermission between successive soakings will ordinarily prove optimal, and from fifteen minutes to half an hour of actual soaking will usually not only prove ample for the purpose under discussion but will often exhaust the patient's strength as much as is permissible. However, the successful treatment of infected wounds, like the successful treatment of all other conditions in surgery, goes not by the clock but according to certain individual variations which can be recognized and evaluated only by the critical eye of a trained and thoughtful attendant, and the matter of time must become, in the case of infections, subservient to the progress of the condition rather than the reverse.

Hypertonic solutions should, needless to repeat, be heated before use; a temperature of 110°F. is as cool as they should ordinarily be allowed to become, and they may be tolerated very much warmer than this especially by certain patients.

Gauze dressings covering wounds undergoing the immersion treatment should be changed in most cases not less frequently than once a day; in the case of foul wounds more frequent dressings are, of course, indicated. Repeated immersion may be permitted in the same solution providing the latter be sterilized by boiling between successive immersions and providing also that it does not become obnoxious through progressive contamination.

The soaking of infected wounds presents one disadvantage dependent solely upon mechanical considerations and one which may or may not prove serious depending upon circumstances. For the most obvious reasons any part of the body which is to be immersed in a solution must be made dependent and must be kept so as long as the process of immersion continues. The patient with serious infections of the extremities is, of course, not an ambulatory patient, and in order to allow actual soaking of parts of such a patient's body, the part in question must usually be allowed to hang over the edge of a bed, or at least such a position of the extremity must frequently be assumed that the blood supply to the member is embarrassed. Adequate arterial blood supply to, and adequate venous return from infected areas is the sine qua non of the effective treatment of infection, and no accessory treatment however painstakingly elaborated can at all compensate for failure to respect this basic principle. The immersion method will signally fail in the hands of thoughtless surgeons who

permit infected areas to become engorged with venous blood and infiltrated with edema.

The other alternative to the placing of an infected area in a solution is the placing of solution on the infected area. The latter expedient is, of course, more universally applicable than the former; not only may such a method be adopted for use on the extremities but also upon the trunk, head and neck. In the simplest case such a method would involve the simple pouring of the solution over the uncovered infected area, but such a procedure would usually not be feasible because of the almost unavoidable concomitant flooding with solution of bedclothing, splints, and other incidental and supportive paraphernalia. Furthermore, the value of gauze coverings which has been previously stressed is here likewise in point, and, accordingly, the expedient usually adopted consists either in saturating with solution dressings already applied to the infected area or in applying to the infected area dressings previously saturated with the solution. The former method may most conveniently be employed in the case of the extremities; these may be arranged, in suitable cases, over protective sheets of rubber or other impervious material so that any excess of solution which may be applied may overflow onto the protective sheet and be conducted away without soaking either the bed or indifferent parts of the patient's body. For infected wounds of the torso, head, neck, and usually also for the extremities the application of wet compresses is the more suitable method.

As compresses inevitably lose heat with considerable rapidity, and as the heat content of the compresses accounts for much of their therapeutic action either the compresses must be changed very frequently or else some method of applying external heat must be employed. It is usually impracticable to change hot dressings as often as they become cool, and consequently the usual expedient is to apply some additional source of heat external to the compress; this may consist of hot water bottles or an electric heating pad applied over the

dressing, an electric light globe suspended directly adjacent to the dressing, or perhaps best of all the electric light tent. Hot water bottles and electric pads are intrinsically objectionable partly on account of the additional weight which they impose on the tender wound area and partly upon the difficulty frequently encountered in keeping the temperature optimal and constant; the hot water bottle, of course, progressively loses heat, and the electric pad, though it maintains a constant temperature, may or may not be capable of maintaining an optimum temperature. The temperature within the electric light tent, on the other hand, may be so adjusted by cutting in or out of the circuit electric light globes so that the heat supplied is optimal and once adjusted tends to remain constant; the apparatus also removes the weight of the bedelothing from the wound.

As the therapeutic value of compresses depends to a considerable extent upon the hypertonicity of the solution used in preparing them, care should be taken to ensure that a sufficient amount of solution is employed to ensure bathing of the wound surface with solution, and this will sometimes entail pouring additional fluid directly onto the compress after the latter has been arranged in place. Furthermore, the principle of alternation of tryptic and antitryptic activity should be respected, and this necessitates particular attention to the renewal of compresses or addition of fluid, as the case may be, during the period assigned to the production of tryptic activity; during the period of antitryptic activity the dressings may, of course, be allowed to become dry.

Compresses should be changed as often as they become unduly soiled by wound secretions, and formal redressing of the wound, accompanied by careful inspection of all details of the treatment, should be performed by the attending surgeon not less frequently than once in twenty-four hours.

Even though compresses, soaks, or irrigations may be required in the treatment of infections for a period of several days, a 5 to 10 per cent salt solution is ordinarily sufficiently Book Page 408

hygroscopic to prevent softening and maceration of tissues providing only periods of rest be alternated with periods of active treatment, as has been described. The secretions from certain wounds harboring virulent infections, however, may occasionally tend to establish suppurative processes in the skin appendages of the healthy area surrounding the infected wound, and this tends to occur particularly when secretion is abundant and when the location of the infection favors friction between the skin surface and gauze dressings. In cases in which wound secretions are particularly copious and are therefore likely so to dilute any hypertonic solutions that may be applied as to reduce the hygroscopic effect of the latter to a minimum, it may occasionally be well not only to increase the percentage strength of the hypertonic solution slightly, but also to sponge skin areas adjacent to the wound with alcohol once or twice a day in order to destroy as many as possible of the surface bacteria contained thereon and also to withdraw water from the skin and thus prevent unnecessary maceration. The latter suggestion constitutes no exception to the rule that antiseptics should not be used in infected wounds; when using alcohol in this manner it is carefully prevented from entering the wound itself.

Wet dressings for application to infected wounds consist of several layers of gauze wrung out of the desired solution. In order to prevent secondary contamination of acutely infected wounds, the solution, the container for the solution, and the gauze used should, of course, be quite sterile and the manipulations incident to the wetting of the gauze and the transference of the compresses to the wound should be such as to insure continued sterility. It is usually possible to prepare and apply compresses by means of the intermediation of sterile instruments and thus to avoid time-consuming sterilization of the hands and the use of sterile rubber gloves, as only enough solution need be expressed from the compresses so that they do not drip. If, however, a situation arises in which instru-

mental manipulation of compresses does not suffice the hands must be prepared as carefully as for a formal operative procedure before they are allowed to come in contact with compresses or solution.

The temperature of solutions used for the preparation of compresses should be high enough so that, allowing for inevitable loss of heat during incidental manipulations, the finished compress as it reaches the wound is as hot as can be borne by the patient. Compresses built up out of several different gauze pads or squares can frequently be made to conform better to the contour of the infected part than a single, more bulky compress, prepared in one piece.

Over the finished compress there should be spread a layer of some material impervious to moisture; this may be a piece of thin rubber (rubber dam), a piece of mackintosh cloth (rubberized fabric), or a piece of oiled silk. This last layer serves the double function of preventing the escape of heat and moisture from the compresses and also of protecting the patient's garments and the bedclothing from soiling.

In the case of wounds which have passed the stage of acute infection, which show a tendency to become indolent, and are difficult to keep clean, it is often best to start a regime of daily or even more frequent ordinary tub baths. Such treatment is especially applicable to infected abdominal wounds of two or three weeks' standing which show little tendency to heal, infected amputation stumps which are not acutely inflamed, decubitus ulcers, leg ulcers and similar lesions. In these lesions the local resistance of the tissues has been built up to such a point that secondary acute infection occurs with difficulty and only very rarely, and the primary indication is for macroscopical cleanliness. No form of bed treatment can accomplish for these lesions what ordinary washing in quantities of warm water can achieve.

Stimulation of epithelial and granulation tissue: Clinically it would seem highly desirable in certain cases to have at one's disposal some special method or methods for the stimulation

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of the two types of tissues upon the formation of which one depends for wound healing, epithelial tissue and connective tissue.

There are grounds for serious doubt, however, whether any such method or methods have been devised up to the present time. At all events no good scientific or experimental evidence has apparently been presented to show that any of the various substances or devices used for the purpose in question do in fact, accomplish that for which they were originally intended. The evidence for the value of special tissue stimulants is purely clinical, and there is little indisputable reason for believing that they accomplish more than can be expected from the use of the methods already described in connection with the control of sepsis, for the formation of new tissue and the control of sepsis are in reality but different aspects of the same process, new tissue being formed if and when physiological processes favorable to its growth have been established.

Undoubtedly stimulation of new tissue formation, whether of the connective tissue or epithelial variety, depends upon the overcoming of conditions unfavorable to such growth rather than upon any specific drug action.

As an epithelial stimulant the fat-staining dyes scarlet red and sudan 111 have been used with some success clinically for more than twenty years. Scarlet red in an 8 per cent ointment was recommended by Schmieden in 1908, and though there is apparently no experimental evidence that it is of value in promoting epitheliazation clinical experience would seem to justify its use. Davis recommends that the ointment be applied to the epithelium around wound edges only and that this be followed by the application of a bland ointment at the end of forty-eight hours.

For the stimulation of connective tissue local applications of certain drugs, notably silver nitrate and balsam of Peru, have enjoyed the favor of clinicians for many years and seem to have established their practical value sufficiently to warrant their use occasionally. Silver nitrate is used either in the form of a

strong solution (commonly a saturated solution) or in the form of the pure fused chemical, molded into sticks. Balsam of Peru is perhaps best applied in a menstruum of castor oil in the proportion of one part of the former to three parts of the latter.

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CHAPTER XIII POSTOPERATIVE PERITONITIS

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CHAPTER XIII

POSTOPERATIVE PERITONITIS

Peritonitis may, of course, constitute the essential condition for which a patient primarily undergoes treatment, or it may, on the other hand, develop as a complication in cases under observation for other conditions whether in the preoperative or postoperative period. Furthermore, the development of peritonitis, though constituting fundamentally a surgical condition, may require early or late operative intervention or may never require formal operative procedures depending upon the variety of the condition which presents itself, and the convictions, knowledge, and experience of the attending surgeon. Perhaps no more distressing dilemma occurs in all surgery than that which develops in connection with cases of peritonitis in which the decision must be made whether to operate or to adopt or maintain conservative treatment.

1. ETIOLOGY OF PERITONITIS

One has but to recall the etiology of peritonitis to realize that almost any variety of the condition at all may be encountered both as a primary clinical entity and as a postoperative complication or sequela. In order of frequency the various causative lesions are:

- (1) Perforations of the gastrointestinal tract, whether due to
 - (a) traumata from within, as by foreign bodies, or traumata from without, as by gunshot and stab wounds,
 - (b) ulcerations of the intestinal wall, whether peptic, malignant, or due to some bacterial agent like Bacillus typhosus, Bacillus tuberculosis, or Treponema pallida, and

- (c) devitalization of tissue primarily due to interference with the blood supply, as in strangulation ileus, mesenteric thrombosis, or diverticulitis.
- (2) Affections of the female genital organs whether
 - (a) traumatic, as in childbirth injuries and abortions, or
 - (b) bacterial, as in tuberculous, puerperal, and gonococcal infections.
- (3) Perforative lesions of the biliary system and pancreas, whether
 - (a) traumatic, as in gunshot and stab wounds, or
 - (b) bacterial, as in suppurative cholangeitis and cholecystitis, hepatic abscess, and pancreatitis.
- (4) Lesions of the urinary and male genital tract whether
 - (a) traumatic, like rupture of the bladder, or
 - (b) suppurative inflammations of the bladder, prostate gland, seminal vesicles, and kidneys.
- (5) Miscellaneous traumatic and bacterial lesions in tissues adjacent to the peritoneal cavity, such as abscesses primarily of the retroperitoneal lymph nodes, extensions of suppuration from the pleurae and pericardium, and infections of the umbilicus in the newborn, and
- (6) Hematogenous infections.

II. THE DIAGNOSIS OF ACUTE GENERALIZED POSTOPERATIVE PERITONITIS

The diagnosis of acute generalized peritonitis developing on the basis of some formal operative procedure is usually not difficult. Characteristically, if the medical attendant is familiar with the particular variety of operative procedure performed, some more or less obvious source of infection can be reasonably suspected, such as leakage from the stoma of a gastroenterostomy, contamination of the peritoneum during the removal of an acutely inflamed appendix, accidental instrumental perforation of the intestinal tract, or some other establishment of contact with a septic focus. In a certain small percentage of cases no such obvious mechanism of contamination is evident, and this situation always makes an early diagnosis of the condition much more difficult.

Rapidly Overwhelming Peritonitis: The peritoneum possesses remarkable powers of resistance against infection, and suppurative peritonitis does not necessarily ensue even though considerable numbers of virulent organisms be injected directly into the peritoneal cavity, provided the continuity of the peritoneum is unbroken and the membrane itself is not devitalized by the previous presence of foreign bodies or the action of chemical toxins.

On the other hand, patients may die from the effect of toxic absorption from an intact peritoneum provided infectious organisms or their toxins be introduced directly into the peritoneal cavity in sufficient quantities. Frequently in the days before the advent of aseptic methods, large numbers of organisms having been introduced into the abdominal cavity at the time of operation, the patient was seen to develop within the space of a very few hours a profound toxemia accompanied by relatively few signs of peritonitis and to succumb within a day or two to the effects of toxic absorption.

Such a variety of fulminating peritonitis is seldom seen at present. It occasionally occurs (1) in cases of prolonged laparotomies accompanied by the infliction of severe trauma to the intra-abdominal viscera when associated with gross lapses in aseptic surgical technique and (2) also in those rare cases in which by some mischance the contents of a septic focus occurring outside of the peritoneal cavity is suddenly released into the abdomen. Patients suffering such mishaps rarely live longer than seventy-two hours; inasmuch as the condition is overwhelming in nature from the start, the diagnosis may remain in doubt unless elucidated at autopsy, and in any case the treatment matters little from the point of view of the final outcome.

III. ORDINARY POSTOPERATIVE PERITORITIS

The mode of onset of ordinary postoperative peritonitis varies considerably. Amongst the most important determining factors is the nature of the source of the process. Certain processes are primarily irritative and only secondarily infective, e.g., contamination of the peritoneal cavity with such foreign fluids as gastric contents, urine, bile, and blood. Peritonitis thus caused is characterized by an acute onset of symptoms which are dependent upon peritoneal irritation. These symptoms are most severe when the fluid is most irritating, e.g., highly acid gastric contents, and least severe when the fluid is comparatively bland, e.g., blood and bile. Occasionally a most important consideration in differential diagnosis is the fact that such a peritonitis may develop either immediately after or at least within a very few hours of the operation, whereas peritonitis due to bacterial invasion undergoes a characteristic incubation period, or period of establishment, which is not ordinarily less than a full forty-eight hours. Although the variety of peritonitis due to various perforations begins essentially as a chemical peritonitis, it very definitely tends to proceed to frank suppuration, and in its later stages it usually differs in no essential particulars from the pyogenic form which will be discussed in greater detail presently.

A. Peritoneal Irritation: Peritoneal irritation produces certain rather typical symptoms and signs. In the initial stages the condition of shock tends to occur; this is characterized clinically as in all types of shock, by drawn facies, cold extremities, accelerated pulse, normal or subnormal temperature, and depression of blood pressure. The degree of shock is roughly commensurate with the amount of intra-abdominal spillage, taking always into consideration, as previously stated, the character of the fluid.

Other symptoms and signs of value in recognizing the process as an intra-abdominal lesion and localizing its position therein are the occurrence of:

- (1) Abdominal pain, which may be intense in case irritation is extreme, which may be localized to the region of the abdomen primarily involved, but always tends to be diffuse and to have a certain maximal intensity in the region of the midabdomen or umbilicus, probably because this region corresponds to the topography of the root of the mesentery through which all pain impulses derived from the small intestine and its mesentery must travel regardless of the part of these structures primarily involved.
- (2) Splinting of the abdominal muscles, which, on the one hand, produces a markedly thoracic type of breathing, and, on the other hand, conveys certain impressions to the senses, to the eye a picture of retraction of the abdominal wall and to the touch a sensation of rigidity which tends to be board-like in character and may or may not be most definite over the primary focus of the process.
- (3) *Tenderness*, which is characteristically acute and may be generalized or localized to the area primarily involved.
- (4) Possibly also dulness in the flanks provided the amount of effusion is considerable; however, because of the intense splint-like action of the abdominal musculature other signs of free fluid in the abdomen frequently cannot be satisfactorily elicited.

As this variety of lesion progresses it gradually assumes the characteristics of the more slowly developing peritonitis which is not secondary to gross peritoneal soiling, but rather arises as a gradual inflammatory reaction secondary to the growth of an initially small number of bacteria.

B. General Symptoms and Signs of Infective Peritonitis: As already mentioned, in case postoperative peritonitis develops as a result of contamination of the peritoneal cavity with only a relatively small number of bacteria at the time of operation, there characteristically ensues a period of some forty-eight to seventy-two hours during which exaltation of virulence and multiplication of the organisms occur, and few or no symptoms referable to the abdominal cavity are produced. During this incubation period patients may apparently undergo a normal postoperative reaction with only a slight elevation of the pulse rate and temperature and present no premonitory indications of the crisis about to precipitate itself; but more commonly such patients appear rather unduly toxic from the first, though the reason for the toxicity becomes apparent only in retrospect when certain symptoms and signs about to be described become manifest.

In this variety of peritonitis abdominal pain is frequently minimal or rarely entirely absent, in marked contradistinction to peritonitis occurring preoperatively, and peritonitis due to perforation of intra-abdominal organs. On physical examination the patient with postoperative peritonitis usually appears restless and anxious, except in the later stages in which there may occasionally develop apathy and even delirium; the face is usually not flushed but cool and moist. The patient lies flat on the back and shows unwillingness to shift his position except for his head, which he frequently rolls from side to side. Due to fixation of the muscles of the abdomen, deep breathing is impossible, and consequently a shallow and moderately accelerated type of respiratory movement is characteristically noted. The patient both looks and feels sick.

Symptoms referable to the alimentary tract include:

- 1. Brownness and dryness of the tongue; in the later stages the lips may also become dry, fissured, and covered with sordes.
- 2. Nausea and vomiting which in the early stages are due to reflex irritation from the peritoneum, but in the later stages represent the development of paralytic ileus.
- 3. Suspension of intestinal activity which early manifests itself simply by obstipation, but later, as paralytic ileus develops, by abdominal distension secondary to accumulation of fluid and gas in the intestines.

Characteristic changes in the pulse rate and temperature require especial consideration. Of the two, the pulse rate is by far the most reliable indication of the extent and progress of the lesion. There invariably occurs an acceleration of the cardiac rate, but in the early stages before toxemia has become well established this acceleration may be very moderate indeed; in fact, a pulse rate of 80 to 90 to the minute is by no means incompatible with extensive peritoneal inflammation. However, within a period of twenty-four to thirty-six hours after peritonitis has become established septic absorption becomes more pronounced, the cardiac, and indeed the

entire circulatory musculature, loses tone, and from this time forward a mounting pulse rate can be taken as a definite indication of an extension of the process or a failing resistance on the part of the patient.

The temperature is a much less reliable guide in prognosis. Except in its terminal stages peritonitis rarely produces a fever higher than 103° or 103.2°F. Initially the temperature may even show a depression to subnormal levels in case very rapid invasion of the peritoneum occurs, as in the case of rupture of a septic focus such as an abscess or ulcer. In the established case a temperature between 100° and 101°F. when taken by rectum is the rule, and it should be standard practice to take the temperature of patients with peritonitis in this way because temperatures taken by mouth or axilla are apt to be misleadingly low.

In infective or purulent peritonitis the leucocyte count is invariably increased; the usual count varies between 12,000 and 20,000 leucocytes per cubic millimeter of blood. An inordinately high leucocytosis should make one suspicious of some other lesion, especially pneumonia. The percentage of polymorphonuclear cells characteristically furnishes a rather accurate guide to the virulence of the infection except in those cases in which the peritonitis is overwhelmingly virulent. A percentage of 80 or more usually indicates a severe infection. It should also be stated that extensive chemical peritonitis, such as produces the symptoms and signs of peritoneal irritation already described does not produce polymorphonuclear leucocytosis unless it becomes purulent; consequently, unless the leucocyte count shows at least 70 or 75 per cent of polymorphonuclear cells the peritonitic process is probably not of the purulent variety.

Abdominal tenderness and rigidity are as characteristic of postoperative as of preoperative peritonitis. Both of these signs are of some value in localizing the primary source of the process since they tend to be maximal in the part of the abdomen primarily or principally involved. Spreading tender-

ness and rigidity invariably indicate spreading infection, and consequently these two signs are of definite prognostic value.

The presence of fluid in the abdomen may be detected by the physical signs characteristically found in such a condition, i.e., (1) dulness in the flanks, which tends to shift on changing the patient's position, and (2) in case the amount of fluid is considerable and only few adhesions are present, fluctuation or a fluid wave. The amount of fluid is not, however, of any very great prognostic significance in the purulent variety of peritonitis. The presence of free gas in the abdominal cavity is, of course, always indicative of a perforation of the alimentary tract; the presence of free gas, however, is only rarely demonstrable even when perforations are known to have occurred.

IV. THE VALUE OF SECONDARY OPERATIONS IN THE TREATMENT OF DIFFUSE PERITONITIS

Much could be written on the subject of the value of operative procedures in the treatment of diffuse peritonitis. The question has been debated frequently and with fervor and probably only some revolutionary experimental or clinical finding could change the convictions of most surgeons on the subject. The present discussion makes no attempt to marshal the evidence either "pro" or "con" since the fundamental purpose of this treatise is not to give the indications for operative procedures but rather to outline the care of patients after the decision either for or against operation has already been made. In a general way, however, it may be stated that operative procedures for diffuse postoperative peritonitis are usually much less valuable than for preoperative peritonitis except in those cases in which such accidents as rupture of intestinal suture-lines, massive intra-abdominal hemorrhage due to slipping of a ligature about some arterial vessel, bile leakage, or some other source of peritoneal contamination, which can be definitely controlled by reoperation, can be

diagnosed with some surety. Within these limitations the value of such secondary operations, as indeed the value of primary operations for diffuse peritonitis, undoubtedly varies considerably with the personal element, and only as a result of considerable individual experience can one say with any degree of certainty whether conservative or radical therapy offers any particular patient the better prognosis.

The general subject of operative technique in case secondary operations seem indicated is, of course, quite beyond the scope of the present discussion.

V. THE CONSERVATIVE TREATMENT OF PERITORITIS

Once the decision has been made to adopt conservative therapy and postoperatively in cases subjected to secondary operation, certain very definite rules of treatment can be formulated regardless of the etiology of the peritonitis. The line of treatment determined by these rules is generally associated with the name of the late A. J. Ochsner, and justly so, not only because he was very largely instrumental in formulating them, but more especially because throughout a large portion of his active life he devoted much of his time and influence to popularizing them even at times when opposition was almost overwhelming. The Ochsner treatment is as follows:

(1) Possibly most important of all is the absolute interdiction of anything whatsoever by mouth. Nurses and occasionally even internes frequently construe this to mean "nothing but water" or "nothing but weak tea" unless specifically told to the contrary. The purpose of this measure, however, is to put the gastrointestinal tract at as nearly complete rest as possible and thus to favor the formation of protective adhesions while at the same time preventing the spread of the infection by the massage of intestinal loops one against the other as the result of peristalsis. For this reason water or any other substance whatever by mouth is strictly contraindicated.

- (2) Peritonitic irritation tends to produce reverse peristalsis in the intestinal tract, and, because succus entericus is always present in the upper small intestine, to favor the regurgitation of intestinal contents into the stomach. The presence of such material in the stomach not only tends to excite normal peristalsis and thus to maintain intestinal activity, but because of its irritating properties it usually excites morbid massive spasms of the gastric musculature and a peristent kind of vomiting. This vomiting is not only physically exhausting to the patient but if frequently repeated tends very rapidly to produce a condition of systemic dehydration and hypochloremia. Accordingly, the prevention of vomiting is a matter of considerable importance. The best method of treating this variety of vomiting is the institution of gentle but thorough gastric lavage using large quantities of warm water. In the less amenable cases in which attacks of vomiting tend to recur again and again, it may become advisable to leave a small gastric or duodenal tube in situ, thus providing a ready vent for any secretions which subsequently may re-form in, or find their way into, the stomach or duodenum, but the mere presence of the tube may in certain cases provoke nausea and vomiting and may thus serve to defeat its own purpose.
- (3) Food and water per os having been interdicted, it becomes incumbent upon the medical attendant to provide these substances parenterally or by rectum. Water is far more important than food, and if patients can be prevented from becoming dehydrated they can usually withstand deprivation of food remarkably well even for relatively long periods of time. Usually, however, both food material and water can conveniently be given in conjunction the one with the other in the form of dextrose solution. Four or five liters of solution during the course of each twenty-four hours should be introduced into the body of an adult person suffering from peritonitis, and the channel through which the administration should be made is a matter of relative indifference so long as it be not

introduced into the stomach; proctoclysis, hypodermoclysis, and intravenous infusion either individually, consecutively, or in conjunction may be employed depending upon circumstances, but when employing proctoclysis the attendant must make sure that the solution is actually absorbed and not evacuated into the bed, and when using intravenous infusion the possibility of postinfusion reactions must be carefully considered. The intravenous drip of Matas is particularly suitable in the severest cases. In those cases in which vomiting is profuse the danger of hypochloremia must not be forgotten, and in such cases the administration of sodium chloride solution either alone or in conjunction with glucose should be adopted, the amount and percentage strength of the sodium chloride in the solution depending upon the degree of hypochloremia as shown by chemical examination of the blood.

- (4) Because of the difficulty of diagnosing and treating abscesses in the upper portion of the abdominal cavity as well as the intrinsic risk to life of such complications, and because diffuse peritonitis always tends to localize in the more dependent portions of the abdominal cavity providing the patient's resistance is adequate to prevent early death from toxemia, it is most important in all cases to favor the gravitation of the infected fluid contents of the abdomen to the region of the pelvis. In this locality not only can the clinical progress of the local reaction be much more conveniently and accurately followed because of the digital approach afforded by the natural body orifices, the rectum and vagina, but also in case it becomes necessary to drain purulent foci surgically the approach in this locality is much more direct. Accordingly the assumption and maintenance on the part of the patient of an exaggerated head-high, or Fowler's position, is of great importance.
- (5) If the diagnosis has been definitely established and pain is severe the administration of morphine may be of value initially; prolongation of such medication is usually, however, not only unnecessary but also highly undesirable both from

the point of view of the possible development on the part of the patient of the morphine habit, but also intrinsically, since there is some very good evidence to support the view that morphine actually tends to stimulate intestinal movements. This matter, is of course, not in accord with the generally accepted view of the action of the drug, but it seems nevertheless to be fairly well established experimentally. Furthermore, morphine administration definitely tends to mask the symptoms of tenderness and rigidity upon which the medical attendant is partly dependent for his prognosis.

(6) Of very definite value in controlling pain is the local application of either heat or cold to the abdomen. Symptomatically both of these physical agents are of approximately equal value, and for this reason there are some who consider the question of which to use of little or no significance. On the other hand, many surgeons habitually use either the one or the other as a matter of routine, in spite of the fact that when pressed for some reason for so doing they may be unable to present any very good scientific basis for their preferences.

The application of heat has at least one very definite practical advantage in that it can be applied through the medium of a heat tent without adding a burden of physical weight to the patient's abdomen; indeed, the heat tent lifts the bedclothing away from the abdomen and thus relieves the patient of much of the weight which his body would otherwise be required to sustain. It has been maintained that local external heat is of definite advantage intrinsically in that it produces a reflex dilatation of the splanchnic vessels, though the evidence for this is not convincing. Probably the truth of the matter is that, aside from the symptomatic relief of pain, externally applied heat or cold serves simply to raise or lower the general body temperature, and whether to use the one or the other is a question which must be decided on this basis.

This conservative regime, though technically simple and theoretically easy of execution, is actually most difficult in Book Page 518

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practice. The difficulty lies not so much in what is done but rather in the constant vigilant inactivity which is demanded of the medical attendant. The patient is apt to complain that he is being neglected, relatives and friends are almost sure to concur in this belief in case it is entertained by the patient, and usually even though the patient himself may be confident they adopt an attitude of distrust of the practitioner's skill and ability; added to this in certain cases will be an attitude of pessimism among the practitioner's own professional colleagues. In spite of this the medical attendant must maintain his therapeutic position for a number of days, frequently for a week or even longer, in the presence of a condition which shows no tendency to change for the better.

The administration of fluids and food by mouth must be interdicted as long as there are any signs of peritonitic activity, or until definite evidences of localization of the process become evident. Usually this involves prolongation of the regime until the patient's temperature has reached a normal level and has remained there for two or three days and the pulse rate has declined to and has become stationary at a normal level. If per os administrations are allowed too early an exacerbation of the process tends to occur immediately, and this invariably presents an indication for a return to the previous strict regime, a procedure which is not only discouraging to the patient and his friends but doubly trying to the medical attendant because it tends to shake his own confidence in the efficacy of the treatment. For this reason it is well for those not thoroughly familiar with this form of therapy to prolong the original treatment somewhat beyond the time at which they may think a relaxation of vigilance might be permissible.

The first article of diet to be allowed is, of course, water. This should be given very cautiously at first and in teaspoonful doses. Providing a twenty-four hour trial of this administration is well tolerated a very gradual addition of nutriment in the form of sweetened tea, beef tea, strained soups or

bouillon, and the like may be cautiously made until a soft, and later a full, diet is tolerated.

If the conservative treatment fails there is nothing further to be done and the patient gradually succumbs. On the other hand, if the patient rallies under such treatment the ultimate outcome of the case may depend to a very considerable extent on the alertness of the medical attendant in recognizing and properly treating certain complications about to be described under the heading of residual abscesses.

VI. RESIDUAL ABSCESS FORMATION

Although residual abscess formation tends to occur as a complication or sequela of diffuse peritonitis, and the institution of timely drainage would seem to be of value in minimizing such a development, these abscesses do occur with a considerable degree of frequency even in patients treated operatively, and therefore such lesions are by no means confined to patients treated solely by conservative measures. Thus Bancroft found secondary intra-abdominal abscess formation occurring in 1.6 per cent of nondrained cases of appendicitis, whereas 6.2 per cent of drained cases developed such abscesses.¹

Furthermore, the development of intra-abdominal residual abscesses in cases in which diffuse peritonitis has not previously been recognizable, though a relatively infrequent occurrence, is one which may be, and probably is, more often overlooked than recognized, particularly in its initial stages. It has been estimated that in abdominal surgery a continuous postoperative fever in the absence of other recognizable causes for the same may be assumed to arise from wound infection either superficial or deep in about 90 per cent of cases, whereas the remaining 10 per cent will be represented by residual abscess formation of the type mentioned.

Several different types of residual abscesses have been described in accordance with their various sites and anatomical relations (Fig. 53):

- A. The Douglas's or pelvic abscess
- B. The lower right abdominal abscesses
 - 1. The ilio-inguinal
 - 2. The ceco-medial
 - -superficial
 - -deep
 - 3. The posteroparietal
- c. The lower left abdominal abscesses
 - 1. Low (ilio-inguinal)
 - 2. High
- D. The subphrenic abscess
- A. THE DOUGLAS ABSCESS: In properly treated cases of diffuse peritonitis there is a very definite tendency toward the formation of residual abscesses in the most dependent part of the abdominal cavity, i.e., in the pouch of Douglas in the female (the rectouterine excavation), and in the rectovesical space (or rectovesical excavation) in the male. Abscesses in these locations are conveniently called collectively "Douglas abscesses." The mechanism by which they are produced depends upon the migration by gravity of peritoneal exudate to the most dependent part of the abdominal cavity, which when the patient is in the extreme Fowler position corresponds with the site of the abscess, and the development of a reaction in three stages (1) a simple local inflammatory reaction in the involved area, (2) the formation of protective adhesions which wall off the process from the general peritoneal cavity, and (3) frank suppuration within the accessory cavity so produced.

Unless especial care be taken to recognize the development of such an abscess it may be completely overlooked, because the portion of the peritoneal cavity in which it occurs is at a considerable distance from the surface of the body so that local evidences of inflammation are not manifest, and furthermore because the pelvic peritoneum is far more tolerant to irritation than the abdominal peritoneum, and consequently the symptoms occasioned by the presence of an irritative lesion in this locality are apt to be minimal. When untreated these

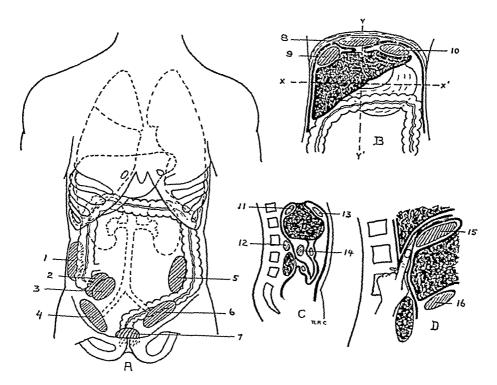


Fig. 53. The more important and common locations of intraperitoneal residual abscesses.

Insert A. Anteroposterior view of various locations of residual abscesses in lower abdomen.

On the right are the following abscesses:

1. posteroparietal

2. .. cecomedial (deep)

3. cecomedial (superficial)

4. ... ilio-inguinal

On the left side of the abdomen are the following abscesses:

- 5. high left abscess
- 6. low (ilio-inguinal) left abscess

In the pelvis is:

7. Douglas abscess

Inserts B, C, and D represent some of the varieties of upper abdominal or subphrenic space infections.

Insert B. Anteroposterior view of the group of subphrenic abscesses which occur between diaphragm and superior surface of liver; in the interest of completeness the location of the extraperitoneal abscess which occurs in the cellular space between the layers of the coronary ligament has been included:

8. extraperitoneal abscess

9. anterior and posterior right upper abscesses

10. left upper abscess

The dotted lines x-x' and y-x' represent the division of the subphrenic space into four subdivisions (Nather and Ochsner).

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abscesses tend to rupture into the rectum or vagina and drain, and thus in a considerable number of cases to progress to spontaneous resolution. In such cases, unless the lesion has previously been diagnosed, the passage of a small amount of pus per rectum or vagina may be overlooked, and the true status of the case may never be recognized.

For this reason it is imperative that the medical attendant in charge of a case of diffuse peritonitis undergoing conservative treatment make frequent digital examinations to determine the condition of this part of the peritoneal cavity. Of course it is true that the Douglas abscess is not frequently entirely symptomless. Usually the development of the abscess has a definite effect on the temperature; postoperatively the temperature may remain elevated in spite of treatment or it may undergo an early return to normal followed by a subsequent elevation at the end of one or more days; occasionally suppuration is delayed for relatively long periods of time and secondary elevation of temperature may occur only after the lapse of several weeks. Martin² and Melchior³ have reported cases in which such abscess formation occurred only after months or years. Associated with the pyrexia in all cases is a leucocytosis. Pain is not usually a prominent symptom, and unless the possibility of the development of this particular condition be kept constantly in mind some other cause will be usually held responsible for such abdominal pain as there is.

Insert C represents a lateral view of right-sided subphrenic abscesses (both upper and lower groups); in the interest of completeness the extraperitoneal perinephritic abscess has been included:

- 11. right upper posterior abscess
- 12. (extraperitoneal) perinephritic abscess
- 13. right upper anterior abscess
- 14. right lower abscess (abscess in Morrison's pouch)

Insert p represents a lateral view of technique of Nather and Ochsner's extraperitoneal approach to the right-sided subphrenic abscesses. The finger peels away the peritoneum from the inferior aspect of the diaphragm and tears its way into the perinephritic space:

15. right upper posterior space

^{16.} right lower space or the extraperitoneal space between the leaves of the coronary ligament as may be desired without invading the general peritoneal cavity.

Locally no symptoms or signs develop so long as the process consists of a mere collection of inflammatory exudate producing mild peritoneal irritation. As adhesions begin to form as a result of this reaction, however, and especially in the later stages when a definite abscess develops, a rather characteristic train of clinical manifestations tends to become apparent.

The symptoms experienced during these later stages of the formation of Douglas abscesses are dependent partly upon extension of the process to neighboring organs and partly to the mechanical presence of a mass in the cul-de-sac. The organs primarily affected are the bladder and the rectum.

In males bladder irritation can be caused more directly than in the female, obviously because in the female the bladder is separated from the rectum by the uterus and adnexa; mechanical pressure, however, even in females may, of course, be transmitted to the bladder indirectly. The symptoms of bladder irritation are frequency and urgency of micturition, accompanied rather characteristically by a sense of fullness or pressure in the region of the bladder.

The effects on the rectum may be either mechanical or irritative and secondary to the inflammatory process. In both sexes the inflammatory collection is, of course, directly anterior to the rectum and causes a certain amount of direct pressure on the rectum and sigmoid; this may give rise to a sense of fullness in the rectum accompanied by constipation. The usual effect, however, is an extension of the inflammatory process to the rectum and the outpouring of inflammatory exudate into the lower bowel with the consequent production of diarrhea. So characteristic is the production of diarrhea according to this mechanism that the medical attendant will do well to consider the possibility of Douglas abscess formation in connection with any laparotomy patient who develops postoperatively an unexplained diarrhea.

Rectal examination confirms the diagnosis, and, as previously stated, should be performed not less frequently than every two days on all patients undergoing treatment for diffuse

peritonitis. The characteristic period of development of Douglas abscess is from five to six days in patients who have been submitted to laparotomy, and for this reason the medical attendant should be particularly on the alert to recognize the development of the condition about the end of the first week.

In the early stages, in which there is present merely a collection of fluid, rectal examination cannot, of course, be expected to be of any value. As adhesions begin to develop, however, and particularly when inflammatory processes begin to occur in adjacent structures the examining finger is able to detect a bulging mass on the anterior rectal wall at about the extreme limit of palpability, and the sign of tenderness can also be elicited by exerting pressure over the mass. The mass is at first hard and indurated and perhaps can be felt to increase in size from day to day. The mucosa of the bowel in the region of the developing abscess rather early conveys to the examining finger the sense of abnormal thickness and succulency. As definite suppuration begins to occur the sphincters at the anus tend to undergo paresis; the resulting relaxation can sometimes be appreciated visually and always manually; the indurated mass in the rectum at this time begins to undergo softening at its center, and this softening tends to progress to actual resorption and rupture of the intervening tissue unless a surgical opening is made for the purpose of drainage.

The process of formation of a Douglas abscess should be followed with careful watchfulness, and surgical intervention should not be invoked too early because a certain percentage of such abscesses tend to undergo spontaneous resolution. Furthermore, too early operative intervention may prove disastrous because, unless protective adhesions have had time to form between the abscess cavity and the general peritoneal cavity, drainage of the abscess involves opening directly into the latter cavity, a procedure which, in the very nature of the case, could hardly fail to result fatally for the patient. During the period of preliminary observation some benefit may possibly be expected from the local application of heat either

in the form of a hot water bottle or hot compresses to the perineum, or the continuous irrigation of the rectum through a special irrigating rectal tube or catheter.

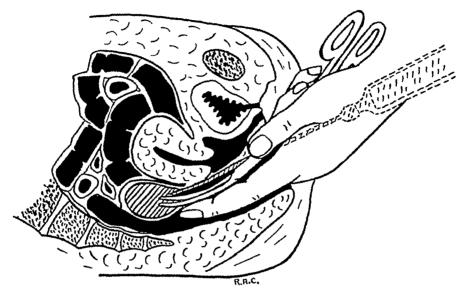


Fig. 54. Suggested technique of opening an abscess in cul-de-sac of Douglas. Abscess is drained through rectum. The gloved finger is first introduced into the rectum and locates point of maximum fluctuation; a long needle is then introduced along the finger as a guide and is pushed into abscess cavity (needle is shown in dotted lines). As soon as pus is discovered and can be aspirated through the needle a curved Mayo scissors is introduced along the needle as a guide and the points are forced into the abscess cavity. Opening thus made is enlarged by opening the scissors and withdrawing them.

As soon as fluctuation can be detected operative drainage is indicated. This may be performed under local infiltration or sacral analgesia, and although the approach in the female may be either through the vagina or the rectum, in the male, of course, only the rectum is available. The operation itself is very simple and should be performed as follows:

An aspirating needle is introduced into the inflammatory mass, using one finger in the rectum or vagina as a guide; as soon as pus has been discovered an incision is made along the needle with a sharp pointed scalpel or bistuary. This procedure is then followed by the introduction of the closed points of a Mayo scissors or the points of an Ochsner forceps into the

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opening thus made and the subsequent enlargement of the tract by opening and withdrawing the instrument according to the method of Hilton (Fig. 54). A drainage tube of soft rubber is then inserted into the abscess cavity and is left sufficiently long to project through the anal sphincters. A "T" binder completes the dressing. The tube is usually left in place until the bowels move spontaneously whereupon it comes away and usually does not require subsequent reinsertion.

B. The Lower Right Abdominal Abscesses: The subdivision of the lower right abdominal abscesses into ilioinguinal, cecomedial, and posteroparietal varieties is of some significance for descriptive purposes, but is of relatively little clinical importance not only because such abscesses have a common etiological background but also because they all present similar clinical characteristics and tend anatomically to overlap or combine.

These abscesses are usually secondary to suppurative processes within the appendix, but occasionally represent complications of infectious processes primarily in the cecum, colon, right side of the spine, and the pelvis.

Because of the modern tendency to treat infections of the appendix by early appendectomy, because of the recognition of the value of the Fowler position in the treatment of diffuse peritonitis secondary to appendicitis, and because of the tendency to provide early drainage in suppurative appendicitis. residual abscesses are less apt to occur in the region of the cecum than elsewhere. Clairmont and Meyer⁴ were able to report only 8 frankly paracecal abscesses and only 3 additional abscesses, located partly on the right side and extending to the suprapubic region, in a series of 1179 cases of acute appendicitis. Cutler, 5 however, reported 10 such abscesses in a series of 18 peritoneal abscesses, or 55 per cent.

The diagnosis of abscess formation in this locality is usually relatively easy, perhaps easier in those cases in which the abscess develops after appendentomy than in other cases. The usual history is that at the time of operation evidences

were found that the inflammatory process had already extended somewhat beyond the limits of the appendix itself, although drainage was not considered necessary. The postoperative reaction of the patient in these cases in not quite normal; the pulse rate undergoes some acceleration, the temperature does not return to normal as it should in uncomplicated cases, the patient appears ill and complains of an unusual amount of pain in the right lower quadrant of the abdomen. Usually the surgeon's first thought is of the development of a seroma or a hematoma, or, if several days have already clapsed since operation, of a localized infection, in the wound. Examination at this time reveals no definite point of tenderness along the line of the incision, such as would be characteristic of a stitch abscess, but a diffuse tenderness and rigidity of the entire right lower quadrant of the abdomen; indeed, if more than two or three days have elapsed since operation the wound should not be tender at all, and the diffuse tenderness surrounding it should make the diagnosis of intra-abdominal infection rather clear.

At this time a definite mass in the affected area may or may not be palpable depending upon the reaction provoked by the infective process. In the early stages of suppuration there is merely an outpouring of inflammatory exudate which, of course, cannot be appreciated by physical examination. As time goes on, however, adhesions tend to form and draw intestinal loops and omentum together in a mass, thus tending to localize the process and to prevent the development of a diffuse and spreading peritonitis; this matting together of the intra-abdominal contents may be palpable for some time before actual suppuration occurs.

As the peritoneal exudate becomes purulent and particularly if protective peritoneal adhesions are not formed with sufficient promptness to prevent the process from spreading, the characteristic symptoms and signs of diffuse peritonitis become increasingly evident. As definite abscess formation occurs the patient's fever usually becomes somewhat higher,

the localizing symptoms and signs, particularly the presence of a local mass, become more pronounced, and if the patient be not subjected to surgical drainage, local surface edema, swelling, and the other signs of localized inflammation may even appear later.

The proper treatment for such abscesses is rather obvious. In the early stages before protective adhesions have been formed every effort should be made to prevent the process from spreading, and the Ochsner method is the treatment of choice. The patient is placed in the Fowler position, the intestinal tract is put at complete rest, the patient himself is kept as quiet as possible, and local applications are provided, particularly the application of heat in the form of a heat tent or hot moist compresses. No attempt should be made to drain the process until the surgeon is sure that the process has become completely encapsulated from the general peritoneal cavity, and this usually takes several days. As soon as a definite abscess has developed surgical drainage is performed the utmost care being taken to avoid opening into the general abdominal cavity.

C. THE LOWER LEFT ABDOMINAL ABSCESSES: Abscesses in the left lower quadrant of the abdomen develop but rarely. Usually these abscesses are secondary to appendicitis, but may occasionally follow traumatic or other perforations of the small intestine or may represent retrograde extensions from the pelvis. In cases of situs inversus viscerum the mechanism of production of the left-sided abscess is of course identical with that of the right-sided abscess in normal individuals, but left-sided abscesses occur as a result of appendicitis even in individuals with normally placed viscera. In such cases, according to Sprengel, the complication may develop in either one of two ways: (a) either a Douglas abscess may form an intermediate link, the left-sided abscess arising by secondary extension from the pelvis, or (b) when some interference to the normal progress of inflammatory exudate into the pelvis occurs at the pelvic brim, this exudate may make its way

directly across the abdomen and localize in the region of the sigmoid flexure of the colon.

From Clairmont's clinic have come two interesting studies of this unusual form of abscess, the first by Nather and Ochsner⁷ covering a period of four years and 700 cases of acute appendicitis with 9 instances of lower left-sided abscesses, the second by Clairmont and Meyer⁴ observed during a period of five years including 1179 cases of acute appendicitis in which there were 12 cases of left-sided abscess and 7 cases of left-sided "infiltration."

The symptoms and signs of these left-sided abscesses are very similar to those occurring on the right side of the abdomen except for their position. The diagnosis of such infections when they occur after appendectomy is perhaps not so easy because the surgeon may at first be inclined to question the validity of the operative diagnosis, thinking that possibly some associated abnormality on the left side of the abdomen was inadvertently overlooked. The treatment of left-sided abscesses differs in no essential respect from the treatment of corresponding lesions on the opposite side of the abdomen, and, therefore, no separate discussion is required.

D. The Subphrenic Abscess: Etymologically subphrenic abscesses could be understood to include all abscesses below the diaphragm, but actually only those collections of pus which occur in more or less close apposition to the diaphragm are usually included in such a classification. According to Freeman⁸ and Winslow⁹ only those abscesses which occur immediately below and in actual contact with the diaphragm at some point should be designated as subphrenic.

The subphrenic abscess has been defined by Godlee¹⁰ as "any collection of pus or pus and gas, the whole or any part of which intervenes between the diaphragm and the structures [normally]* in contact with its lower surface."

In the interests of clarity it is probably best to describe certain arbitrary anatomical boundaries within which all

^{*}The brackets are mine.

abscesses can be called subphrenic, and the colon and transverse mesocolon may conveniently be considered as constituting an inferior limit, the diaphragm being, of course, the universally accepted superior boundary. Accordingly, the subphrenic abscess may be defined as any abscess occurring in the upper abdomen between the diaphragm above and the transverse colon and transverse mesocolon below.

Martinet¹¹ and Bernard¹² were pioneers in the description of the topographical anatomy of the subphrenic region. Nather and Ochsner⁷ amplified and modified the description of these investigators as follows:

The liver divides the subphrenic space into an upper and a lower portion and the falciform ligament into right and left portions, making four spaces in all.

- (1) The right upper space, between the liver and the diaphragm and to the right of the falciform ligament, is subdivided into two minor spaces:
 - (a) the anterior, which is anterior to the right triangular ligament, and
 - (b) the posterior, which is posterior to the right triangular ligament.
- (2) The right lower space, which is below the lower surface of the liver and above the transverse colon and thus corresponds with the space known as Morrison's pouch.
- (3) The left upper space, which is between the left lobe of the liver and the lower surface of the diaphragm.
- (4) The left lower space, which lies between the left lobe of the liver and the transverse colon and which is subdivided into two minor spaces:
 - (a) the anterior, which lies anterior to the lesser omentum and the stomach, and
 - (b) the posterior, which corresponds with the lesser peritoneal cavity.

In addition to these spaces another is sometimes recognized:

(5) The perisplenic space, which surrounds the spleen.

Etiology: Subphrenic abscesses develop in the vast majority of cases as a complication of diffuse peritonitis, or stated in a slightly different way, by extension from some focus of infection within the abdominal cavity.

Formerly observers were in rather general agreement that appendicitis was the most common antecedent lesion. Thus Fagge¹³ believed, in 1909, that appendicitis accounted for 50 per cent of all cases of subphrenic infection. Harsha,¹⁴ in 1919, asserted that 9 out of 10 cases arose in this manner. Ross¹⁵ on the basis of a series of 3391 consecutive cases of acute appendicitis judged that subphrenic abscesses occurred in from 0.5 to 1 per cent of all cases of acute appendicitis. Fifield and Love¹⁶ found 38.4 per cent of 78 cases of subphrenic abscess secondary to acute appendicitis, and Clendening¹⁷ found 66 per cent of his series of cases secondary to acute appendicitis.

The mechanism by which extension occurs can be understood from a consideration of certain simple principles of hydrostatics as shown long ago by Bernard. 12 When a patient lies flat on his back in bed the two most dependent portions of the peritoneal cavity are the subphrenic space above and the pouch of Douglas below; between these two dependent pouches there occurs an elevation consisting of the thick soft parts overlying the normal lumbar curve and surmounted by the kidneys and the perinephritic fat. Coffey 18 found that the upper pouches in the region of the loins were capable of holding more fluid than the pelvis and that in order to drain the flanks of the fluid a patient's body must be elevated to such an extent as to make with the bed an angle of 60 or even 70°. The direction in which exudate arising in the region of the appendix drains, whether toward the subphrenic depression or toward the pelvis, depends therefore upon two factors: (a) the position of the appendix, and (b) the position of the body with respect to the bed. When the appendix occurs retrocecally or retroperitoneally, and posteriorly or laterally to the colon, and when its base is unusually high due to incomplete rotation of the colon, peritoneal exudate from it tends to flow upward, and subphrenic abscess tends to occur. When, on the other hand, the appendix is in its normal position or when it dips over the brim of the pelvis, fluid flows downward

and the development of a Douglas abscess is favored. Furthermore, during the period in which exudation occurs in fluid form and before adhesions have been developed to limit its migration from place to place, the position of the body is of the utmost importance in determining the position at which abscess will subsequently occur. With the body elevated to an angle of 70° virtually all free fluid within the abdominal cavity gravitates into the pelvis, and accordingly subphrenic infection is not apt to develop.

Recently many observers have come to believe that ruptured peptic ulcers account for just as many subphrenic abscesses as appendicitis. Thus Peery, 19 collecting a series of 493 subphrenic abscesses from the literature, showed that the appendix was the origin of the infection in 25.3 per cent of cases, but that the stomach accounted for 23.1 per cent and the stomach and duodenum together for 26.3 per cent of cases. Fagge, 13 who in 1909 believed that 50 per cent of subphrenic abscesses were due to appendicitis, was convinced in 1921 that nearly 80 per cent of such infections were secondary to gastric or duodenal ulceration. In Fifield and Love's 16 series of cases 20 per cent of subphrenic infections were secondary to ruptured peptic ulcer.

Probably it is safe to assume that appendicitis and ruptured peptic ulcer each account for about an equal number of cases, about 25 per cent each. Undoubtedly, furthermore, appendicitis now accounts for far fewer cases than formerly, not only because appendicitis is now diagnosed and treated more promptly than formerly but because more and more attention is being paid to the conservative treatment of peritonitis.

About half of the cases of subphrenic abscess are secondary to other lesions than appendicitis and peptic ulcer. No particular lesion, however, seems to account for any considerable number of cases. In the series collected by Peery¹⁹ suppurative processes in the liver and bile passages were responsible for 8.8 per cent of cases, but aside from this no particular lesion seemed to be responsible for more than 5 per cent of the cases.

Among the miscellaneous lesions are suppurations in the spleen, kidney, and pancreas, tuberculous processes in the ribs and spine, empyema, pelvic suppurations, including tubal infections, traumatic lesions such as bullet and stab wounds, and a number of other processes such as hydatid cysts.

The bacteriology of subphrenic abscesses is variable and depends in part upon the manner of production. Abscesses developing on the basis of an antecedent appendicitis usually contain B. coli and streptococci, and those secondary to a ruptured peptic ulcer often contain staphylococci in addition to B. coli and streptococci. Abscesses secondary to tuberculous processes in the ribs or spine may or may not contain tubercle bacilli, and abscesses which represent extensions from a primary empyema may contain either tubercle bacilli or pneumococci. Douglas²⁰ has reported a case of actinomycotic subphrenic abscess.

Diagnosis: Recognition of the development of subphrenic abscesses is not particularly difficult if the possibility of such a complication is considered. There are, however, usually no localizing signs or symptoms, though there may be a sense of epigastric fullness or distress and occasionally some pain on deep breathing. The classical clinical picture described by Barlow, Leyden, and others many years ago, above the liver dulness a tympanitic zone represented by free gas in the peritoneal cavity, and above this a zone of dulness due to a pleural exudate, is not actually of much value because free gas is present in the peritoneal cavity in only about one-third of the cases of subphrenic abscess, and, furthermore, the tympanitic zone may be simulated by a highly placed, gas-filled, transverse colon.

In the typical case, such as that following appendectomy, the symptoms of the condition may follow within a few days or may be delayed for several weeks; usually, however, in from one to two weeks in a patient who has not been convalescing well the following will be noted:

General Symptoms: The temperature, which may or may not have been normal previously, now rises, or the pulse rate rises in the absence of corresponding increases in the temperature. Anorexia develops, diaphoresis becomes exaggerated, and prostration ensues.

Physical Examination: The usual methods of physical examination often reveal little evidence of localized inflammation, at least in the early stages. As time goes on definite localized tenderness may be recognized on deep pressure, and minor degrees of superficial edema may be noted over the involved area. There is usually no swelling or other evidence of localized inflammation but indirect evidences of the inflammatory process may be elicited: limitation of respiratory motion, especially on the affected side, dulness at the base of the lung on the affected side due either to the presence of a pleural exudate which is usually sterile, or to compression of the dependent lung tissue by a highly arched diaphragm.

Pain on deep concussion and displacement of the apex of the heart to the left are valuable signs when present, but are not usually found.

The leucocyte count is usually high, 25 to 30,000 with a polymorphonuclear count of over 85 per cent.

As an aid in diagnosis x-ray examination is of the utmost importance. The diaphragm on the affected side will be found highly arched, usually rounded, and relatively immobile. The normal excursion which is from 2 to 3 in. in amplitude is often reduced to an excursion of a fourth of an inch or so; occasionally the costophrenic angle will be clouded or obliterated by accompanying fluid in the chest or by bronchitis in this area. The presence of a gas bubble just under the dome of the diaphragm is certainly important when present, but such, as previously mentioned, is very rarely found. It must be remembered that the roentgenological picture of a high, rounded, fixed, dome-like diaphragm is not always indicative of intra-abdominal pathology. It is in certain cases due to

paralysis of one side of the diaphragm; in such cases it is usually not accompanied by symptoms of any kind.

Diagnosis is clinched by aspiration in those cases in which the condition is suspected but cannot be otherwise confirmed. Exploratory aspiration may, of course, be performed either by introducing the trocar horizontally between the ribs or from below the ribs upward; these procedures have very serious disadvantages in that in the former approach the pleural cavity, which is apt to be sterile, is invaded, whereas in the latter approach sterile portions of the abdominal cavity may be contaminated. The approach which is considered least dangerous is described by Nather and Ochsner; it consists in introducing the aspirating needle in the midaxillary line at the level of the spine of the first lumbar vertebra, the point being upward and backward at an angle of somewhat less than 45°; during the aspiration mild continuous suction should be applied to the needle in order that the point may not pass through an abscess cavity undetected and thus infect healthy tissue beyond. Several different punctures or redirection of the needle in various different directions may be required before results are obtained. Naturally this approach is principally suitable for such collections of pus as occur in the right subphrenic spaces; the abscesses which follow appendectomy are characteristically accessible by this method because they usually develop either in the right upper posterior or the right lower spaces.

Treatment: Two classical operative approaches have been described in connection with the drainage of subphrenic abscesses, (1) the transpleural, and (2) the transabdominal. Both of these are open to the objection previously mentioned in connection with aspiration, viz., that in the process of reaching the collection of pus virgin cavities may be traversed. Nather and Ochsner⁷ have described an approach not open to these objections and therefore highly desirable.

An incision is made directly over and parallel with the right twelfth rib and after the latter has been exposed, subperiosteal resection of the entire rib is performed to within 4 cm. of the midline. Transverse incision of the musculature below the former location of the resected rib and at the level of the first lumbar spinous process is now made and careful dissection is carried down to the renal fascia. This fascia having been identified, dissection with the operator's finger is carried upward, and the peritoneum lining the lower surface of the diaphragm, which is continuous with the aforementioned fascia, is carefully peeled away from the lower surface of the diaphragm. The edematous condition in which the peritoneum finds itself as a result of the adjacent inflammation facilitates this process. When the dissection has been carried upward in this manner well onto the dome of the liver, abscess cavities may be sought by the sense of touch or by the exploratory needle (a) in the adjacent subhepatic spaces (right superior posterior, right superior anterior, or right inferior), as well as (b) above the diaphragm (pleural cavity), (c) and in the liver substance. When the abscess cavity or cavities have been thus identified they are torn open by the finger tip, and drainage is thus established to the exterior without contaminating either virgin pleural or peritoneal cavities.

It is important to remember in this connection that abscesses following appendicitis are frequently multiple, one above and one below the liver (Maydl²¹ and Piquands²² 53 per cent, and Bernard¹² 60 per cent of cases).

Prognosis: The prognosis in cases of subphrenic abscess is always grave; when death occurs it is usually due to sepsis. Although it is possible for spontaneous healing to occur either by resolution, as in the case of tuberculous abscesses, or in other cases by rupture and drainage of the abscess either into some adjacent hollow viscus or onto the external surface of the body, cases treated expectantly or conservatively show a 55 to 90 per cent mortality. Sonnenberg²³ places the mortality in cases not subjected to operation at 55.5 per cent, Sachs²⁴ at 71.5 per cent, and Elsberg²⁵ at 82 per cent. The same observers in cases subjected to suitable operative procedures place the mortality respectively at 42, 37.5, and 22 per cent. ¹⁹ Although

in fulminant cases patients may succumb in a few hours or a few days, in the less virulent varieties of infection slow septic absorption may occur over a period of weeks or months without causing death. In cases in which operative drainage is unduly delayed the mortality is higher than otherwise; thus Sachs²⁴ found a mortality of only 13.5 per cent in those cases drained within three weeks whereas in patients operated upon after this period of time the mortality was 50 per cent.

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SIMULTANEOUS LIGATION OF VEIN IN LIGATION OF LARGE ARTERIES

EXPERIMENTAL STUDY*

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In the course of our studies on the physiological factors concerned in the development of collateral circulation in an extremity following the ligation of its main artery, we have studied at considerable length the effect of simultaneous ligation of the artery and vein. In a previous publication we have stated our results on prolonged observation of temperature of extremities in dogs after ligation of the main artery. We were impressed by the rarity of gangrene in these animals after this procedure, and so were led to the experiments to be here reported.

It is our purpose in this paper to critically review the literature both clinical and experimental relating to this problem; and secondly, to present the results of our own experiments.

In the past fifteen years much has been written about the simultaneous ligation of the accompanying vein when a large artery is ligated, and there has been a certain measure of insistence on the part of some surgeons on the necessity of this procedure to prevent gangrene. There has also been some experimental work done both to prove that simultaneous vein ligation does increase the incidence of gangrene, and to attempt to explain how it does this.

While the occurrence of gangrene after ligation of the large arteries has always

been a large problem for the surgeon, and ways have been sought to avoid it, the operation of simultaneous ligation of the vein seems to have had its inception about 1916, during the World War. Reference to the standard textbooks of surgery since 1000, will give some idea of the opinion on this subject current during the first twenty years of the present century. Bickham's "Operative Surgery"2 (1905 edition; same in 1924 edition) says (p. 26): "When it is difficult to separate one or more veins from the artery, the artery and vein or veins may be included in the one ligature. When a large vein is wounded, the wound should be at once closed by lateral ligature or by suture, preferably the former. If this is not feasible, the vein should be ligated." Kocher's "Textbook of Operative Surgery"3 (1911) does not mention simultaneous ligation of the accompanying vein in connection with the ligation of any of the large arteries, or in the indications for the ligature of the larger veins. Ashhurst's "Surgery" (1914) in the rules for the ligation of wounded arteries does not suggest ligation of the companion vein, but says (p. 234): "According to Wolff's statistics (1908) gangrene occurred in 34 per cent of cases where both femoral artery and vein were ligated, and in only 8 per cent where femoral vein alone was ligated."

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Rose and Carless' "Manual of Surgery" (1919) says:

Ligature of the main artery does not produce gangrene in a healthy limb . . . Obstruction to both main artery and vein, if it occurs suddenly, has been looked on hitherto as an almost certain precursor of gangrene . . . As a matter of fact, at any rate in young and healthy people, the ligature of the main vein with the artery for wound of both vessels does not seem to add to the risk of gangrene, but rather to diminish it, and this by reducing the venous congestion in the limb. This has been so marked that military authorities advise that in wounds of the main artery requiring ligature, the vein though unwounded should be tied at the same time. This decision is a strange turnover of surgical practice; it is certainly true for young healthy soldiers with no generalized degeneration or disease of the vessel walls, but its truth will have to be tested for elderly people where arteries have to be tied for aneurysms.

Stewart's "Surgery"⁶ (1921) states (p. 131): "Gangrene from ligature of the principal artery of a limb seldom occurs if the general health is unimpaired, and the limb sound. Obstruction of the principal artery and vein, the result of ligature or injury, is almost sure to be followed by gangrene." Da Costa's "Modern Surgery" (1925) does not mention simultaneous vein ligation either as a help in preventing gangrene or as an added cause of gangrene in ligating the large arteries.

Keen's "Surgery" (1909) mentions (p. 119) among the causes which interfere with the establishment of collateral circulation after ligation of a large artery, "the coincident obstruction of the satellite veins and lymphatics, thus favoring stasis in the peripheral circulation." The simultaneous ligation of the accompanying vein is not suggested in their "golden rules" for the ligation of bleeding arteries. In regard to venous ligation they say (p. 169), "the joint injury of both vessels is the most certain way of causing gangrene of the limb." In the supplement to Keen's "Surgery" (1921) in the chapter on Military Surgery of the Vascular System, R.

Matas says: "In fact, even when we come to the immediate treatment of these large bleeding or exposed blood vessels we are still going back to the Napoleonic Campaigns and applying the 'golden rules.' Sencert has kept notes on 70 cases in which he ligated the great vascular trunks in open wounds within the first few hours following the injury, and in which there was no bematoma. In all these 70 ligations there were only two gangrenes; one of these was a ligation of the femoral and the other of the popliteal. On the other hand, he ligated 42 arteries for diffuse hematoma, and counting only the ligatures which were applied to the large dangerous arteries, he had gangrene in 6 cases: 2 gangrenes in 5 axillary ligations; 2 in 10 femoral ligations, and 2 in 5 popliteal (or 30 per cent gangrenes). Therefore Sencert concludes in a general way that in large open wounds which are subject to thorough and systematic surgical cleaning, the ligature of the large arterial trunks when applied to healthy segments of the vessel is not only the simplest and safest procedure for the patient, but is also relatively safe for the limbs. Makins tabulates 86 ligations of the large vessels (axillary, brachial, femoral, popliteal) which were applied for hemorrhage at the front. These were followed by gangrene of the extremities in 8, or 10.5 per cent. The advocacy of Makins and other British surgeons of the simultaneous ligation of the satellite vein with the injured artery, as a means of increasing the low blood pressure in the peripheral circulation, and thereby tiding over the nutrition of the distal parts until the collateral circulation can be established, shows, if nothing else, that there is a growing appreciation of the urgent need for discrimination in the methods of treatment of wounded blood vessels at the front."

Lewisohn in the "Oxford Surgery," 10 (1920) has this to say, "Since the introduction of aseptic surgery it has been found that not only the main artery, but also the main vein may be ligatured without risk of gangrene, and the two vessels may

even be tied simultaneously with a fair chance of gangrene being avoided, provided that the wound remains aseptic." However, in discussing what to do in case the vein has been punctured during ligation of the artery, he advises lateral ligature or

The policy of simultaneous vein ligation is attributed to Sir George Makins, Surgeon of the British Army during the late war. In view of this it might be well to review his earlier opinion in the matter. In 1916 he reported¹¹ among other vascular injuries from the British service in the early part of the war, 36 cases of injuries to the femoral vessels: 15 of the common femoral, 7 superficial, 9 lower one-third, and 3 of the profunda. Of these, 25 had operations consisting without exception of ligation above and below the wound:

No. Deaths Common femoral... 5 Superficial femoral.. 17 3 6 deaths, or 24 per cent mortality Profunda..... 2 Int. circumflex..... 1

Gangrene occurred seven times in the 36 cases, twice before ligation; I had 'trench feet," I followed two severe secondary hemorrhages in a patient dying of septicemia, I involved only the toes. In I case only it followed the operation of ligature. In all these cases the patients had severe wound infection. So it seems at the time he published this paper Makins did not advise simultaneous vein ligation, and still considered that injury or occlusion of the vein was to be avoided if possible. And considering his statistics on the femoral artery with only one gangrene following the operation of ligation in 25 cases of severely infected war wounds, it is hard to see how the results could be improved.

It is true that Makins in the Bradshaw lecture of 191312 commenting on experiences in the Boer War noted that there was a smaller incidence of gangrene in cases of arteriovenous fistula treated by ligation of the artery and vein, than in those treated by ligation of the artery

alone. But this is a situation altogether different from the ligation of the healthy vein with no fistulous involvement. A similar observation had been reported in 1908 by Oppel¹³ in a vivid and dramatic description of an operation for axillary artery-vein aneurysm done in 1906. Again in 1913 Oppel¹⁴ used and recommended ligation of the popliteal vein for treatment of senile gangrene of the foot.

Before Makins in the actual advocacy of ligation of the healthy vein, the German surgeon, Sehrt¹³ in 1916 made the statement:

The outflow or better the sucking up of the venous blood may be best prevented by ligation of the veins. Everything which accelerates the sucking away of the venous blood (activity of the heart, etc.) from an extremity robbed of its arterial supply must contribute to the death of the part deprived. Thus may be explained cases in which definite gangrene of a segment of an extremity has appeared some little time after the receipt of the injury and after the general condition and especially the heart's force had improved. Everyone may well have seen such cases. Under certain circumstances a severely injured member may be carried over the most dangerous period by venous blockage.

It would seem that the improvement in the general condition, and the force of the heart beat would have just as much effect, if not more, in opening up the arterial collaterals as it would in sucking away the blood from the venous system of the extremity as Sehrt held at that time.

In his Hunterian Oration¹⁶ reported in the Lancet in 1917, Makins for the first time advocated the ligation of the healthy vein when it was necessary to ligate the artery. He states:—

These considerations and others have led me not only to regard obligatory simultaneous ligation of a main artery and vein as a negligible factor in the risk of gangrene of a limb; but to hold further, that the procedure is preferable whether the vein be injured or not; the result of the combined procedure being to maintain within the limb for a longer period of time the smaller amount of blood supplied by the arterial collateral circulation and hence to improve the conditions necessary for the maintenance of the vitality of the limb.

Following this M. Van Kend¹⁷ reported to the Inter-allied Conference of Surgeons at Paris in May, 1917, the results of animal experiments indicating that the peripheral blood pressure in a limb after the simultaneous ligation of its main artery and vein was greater than after the ligation of the artery alone. He advocated the former procedure, holding that it would raise the residuary blood pressure, and thus provide the most satisfactory conditions for the maintenance of the nutrition of the limb. After discussion at that meeting the following conclusion was adopted:

Contrary to what has until now been believed, simultaneous ligature of both artery and vein when both vessels have been wounded does not give rise to increased risks of gangrene; in fact it diminishes them. Facts tend to prove, even when the wound is limited to the artery, that simultaneous occlusion of the unwounded vein is to be recommended.

Tuffier18 took up the suggestion and reported his views to the Société de Chirurgie on July 4, 1917:

There is first a fact which appears well demonstrated; it is that ligation of the vein and the artery in the case of wounds of the two vessels does not increase the danger of ischemia. Moreover, the statistics of the English Army, which Sir George Makins has communicated to us, give in this connection the following ratios: Ligation of the artery alone is followed in a general way by gangrene in 40.2 per cent of cases; whereas, simultaneous ligation of the artery and of the vein under the same conditions gives 24.5 per cent, and I speak only of gangrene from ischemia. The most marked difference is in connection with the popliteal; ligation of the artery alone in 6 cases gave favorable results in 58.33 per cent, and gangrene in 41.66 per cent. Simultaneous ligation of the artery and vein has given in 28 cases 22 favorable results, 76.57 per cent, and only 6 cases of gangrene.

(These figures for gangrene appear higher than Makins' figures for the British Army, 10 reported in 1916.)

In Germany also in 1917 Propping 19 seems to have agreed with Sehrt and says:

One sees, therefore, that my explanation of the possible cause of gangrene of a limb after ligation of an artery goes farther than Sehrt's. In place of "the sucking away of the venous blood" I advance the idea of a disproportion between the in and out flow-to a certain extent a disturbance of balance of these two factors-in order to explain the inefficient filling of the capillary bed and the thereby conditioned derangement of the nutrition of the tissues.

Not much more concerning the subject is found in the literature until after the war. Suffice it to say that Makins' influence made this procedure which he advocated almost mandatory in France and England during the late years of the war, according to Halsted.20 In his book on "Gun-shot Injuries to the Blood Vessels"21 (1919) Makins sums up the arguments in favor of it without any additions to those previously given.

It must not be supposed that the simultaneous ligation of the artery and vein was not done prior to 1916, although the individually reported cases in the literature are few. Hutchinson²² reports the case of such a patient operated on by Horne in 1905 in whom the femoral artery and vein were tied for hemorrhage, and gangrene to the knees followed. Another ligation of the femoral artery and vein for aneurysm by Zondek23 in 1912 was followed by complete recovery. Bernheim and Worth²⁴ in 1914 reported a case of ligation of the right external iliac artery and vein for aneurysm without gangrene. Cowell²⁵ ligated the superficial femoral artery and vein for hemorrhage in 1915, and had gangrene of the tips of the toes. Griebel²⁶ reports a case of ligature of the common iliac artery and vein done by Orth in 1915 with complete recovery of the circulation. Boeckel²⁷ reports 2 cases of ligature of the femoral artery and vein for aneurysm with no gangrene done in 1916. The point to be observed is that before Makins' advocacy of the procedure

in 1917 the operation was done only in necessity, and with a good deal of temerity and increased fear of gangrene. In fact a perusal of the textbooks shows that every operation for the ligation of a large artery was devised with the thought in mind of preserving the integrity of the main vein, even to the instructions for carrying the ligature around the artery so that the aneurysm needle would point away from the vein.

In regard to the opinion on this subject in our own country after the war, let us turn to that master, and dean of the surgeons of that time, W. S. Halsted, who discussed the matter at length in his treatise on the surgical treatment of aneurysm of the subclavian artery. He reported²⁰ some experiments carried out on dogs by Hooker in which the blood pressure taken by cannula from the saphenous artery was shown to fall from 114 to 26 mm. Hg after ligation of the external iliac artery, and then to slowly rise in the course of an hour to 50 mm. Hg. At this point successive occlusions of the external iliac vein resulted in rises in pressure of 20, 12, 8, 3, 10 and 14 mm. Hg. The slow rise in pressure noted after the fall following deocclusion of the vein never equalled the level established when the vein was occluded. Then Halsted says:

Since ligation of the vein raises the blood pressure in the ischemic area, is it not possible that the response of the arterial side for anastomotic development may be delayed or lessened for a period and to a degree conformable to the time and the amount that the vein contributes to the maintenance of the circulation in the extremity? If this is so might not the ligation of the like-named vein be postponed, when this can be done without danger, in order not to relieve the arterial side of its responsibility? Then if after a time there should be evidence of disability from ischemia, such as claudication on exercise, the surgeon would have the ideal opportunity to demonstrate the value of the venous ligation.

Halsted was not at all convinced that gangrene followed aseptic and uncomplicated ligation of the large arteries, for he states:

It is still believed (Wolff, Matas and others) that ligation of the common iliac artery is followed by gangrene in 33 to 50 per cent of the cases. That this belief is erroneous is proved by my careful study of each reported case. On page 215 of my paper is the following statement. "Granted that in the cases of Lange and Cranwell the ligation of the artery was solely responsible for the gangrene, we have only two such cases in the 30 of my collection, a percentage of six and six-tenths. If it should appear later that Cranwell's case might, for unascertained reasons, be excluded, the percentage would be three and three-tenths, and the sum total of gangrene the cutaneous necrosis of one toe." [And then he goes on further to say]: Gangrene has so rarely followed ligation of the sub-clavian and common iliac arteries that in the case of these vessels, I should for the present be disinclined to tie off simultaneously the corresponding vein.

La Roque²⁸ in reporting a case of ligation of the external iliac artery and vein for bullet wound of both these vessels done in 1920 is greatly in favor of simultaneous ligation of the vein. After discussing the opinions of others he says:

The common-sense suggestion occurs that if the blood entering the limb is diminished or cut off entirely, we should at least be sufficiently considerate of the tissues to tie the vein and permit what will of the blood surely containing some food to remain. There is genuine reason for believing that vein ligation favors the development of collateral vessels, and through retention of blood-volume and pressure aids enlargement of vessels already present. [But he also says in two other places in the article]: There is further reason to believe that in the absence of infection, gangrene is never caused solely by ligation of any part of the external iliac or femoral at a point above its communication with the sciatic through the branches of the profunda femoris, [and] if any case of gangrene has ever been conclusively shown to be the result of aseptic ligation solely of the common femoral or external iliac vessels on account of a wound of even moderate recency, the case report is not easily accessible.

Heitz29 writing in 1923 on blood vessel ligature and suture, advocates simultaneous ligation of the healthy vein.

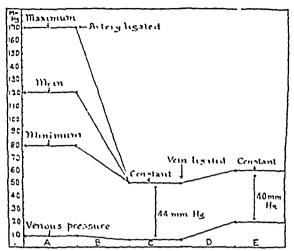


Fig. 1. Changes in pressure in arteries and yeins distal to occlusion of primary artery and subsequent occlusion of vein. A, normal maximal, minimal and mean arterial pressures of external iliae artery and normal pressure in common iliae vein; n, effect of ligation of external iliac artery alone on pressure in artery and vein distal to occlusion; it will be noted that pulse pressure completely disappears and intraarterial pressure falls; there is a slight fall in venous pressure; D, effect of subsequent occlusion of common iliac vein; it will be noted that both arterial and venous pressure rise; arterial pressure rises to point almost as high as minimal pressure in unobstructed artery, and venous pressure higher than normal. (From Brooks and Martin. 30)

So consideration of the clinical literature would seem to indicate:

- 1. That there was considerable controversy over the incidence of gangrene in limbs following the ligation of one of the main arteries, nearly all surgeons, except Halsted, maintaining that it was very high.
- 2. That the policy of preserving the accompanying vein whenever this was possible, and the feeling that occlusion of the accompanying vein when this was necessary when ligating the artery increased the danger of gangrene, were completely changed, and in their stead many surgeons were advocating the simultaneous ligation of the healthy accompanying vein as a means of decreasing the incidence of gangrene. Halsted did not concur in this view.

The experimental literature seeks, for the most part, to establish the validity of this procedure on proved physiological grounds.

In 1923 Brooks and Martin³⁰ published the results of their experimental work on simultaneous occlusion of the iliac artery and vein in animals. Their investigations covered three phases:

- 1. Changes in temperature of the tissues distal to the ligature. Their results on this phase will be discussed later.
- 2. Changes in the blood pressure in the veins and arteries distal to the ligatures. In this investigation, determinations were made on 6 large dogs, and a typical chart of the findings is reproduced here (Fig. 1). It will be seen by reference to this chart that while the fall in arterial pressure is great immediately following ligature of the artery as would be expected, the fall in venous pressure is almost negligible. However, after ligation of the vein, the venous pressure rises considerably above normal, and much greater in proportion to the rise in pressure in the artery, decreasing the difference in arterial and venous pressures. This the authors take to mean an increased resistance to outflow of blood from the extremity, and consequently, a decrease in the amount of blood flowing through the extremity. This point should be recalled in reviewing the work of later investigators.
- 3. The frequency of gangrene after ligation of the artery alone, and of the artery and vein. When the common iliac artery alone was ligated in rabbits, 72.5 per cent of 21 animals developed gangrene. With simultaneous occlusion of the vein 33.3 per cent of 18 animals developed gangrene. It must be said that the percentage of gangrene with ligation of the common iliac alone is much higher than the statistics for man which Halsted puts at 6.6 per cent, and in our own experience with dogs in which we have had no gangrene except in 1 case where the popliteal artery was previously occluded. Their high percentage of gangrene is probably

due to their method of ligation which consisted in ligation of the common and external iliacs just proximal and distal to the origin of the hypogastric thus shutting off the external iliac and the hypogastric at their source, i.e., practically all the blood supply to the limb, which is a much different situation from ligation of the common iliac, or external iliac, or hypogastric individually. This may be due to a peculiarity of the circulation in the rabbit. It does not, however, vitiate the difference found between the results of the two procedures carried out under the same conditions.

The authors concluded that simultaneous ligation of the vein (1) increased the intravascular pressure distally in both veins and arteries; (2) decreased the volume flow of blood; and (3) decreased the incidence of gangrene. They thought that the increased intravascular pressure might bring about a better distribution of blood in the peripheral capillaries, and might aid in the exchange of nutrient substances from within the vessels to the tissues, even though the total volume flow of blood was reduced at the same time, in other words a balance between the arterial and venous systems; and that the simultaneous ligation of the vein would be beneficial or harmful accordingly as the venous obstruction produced would cause to predominate the beneficial effect of elevation of the intravascular pressure, or the harmful effect of the decrease in volume flow of the blood.

In the following year 1924 Brooks in another publication31 repeats these findings, and concludes with this statement:

The necessity for ligation of an artery which endangers the viability of an extremity not infrequently arises. The obstruction of the artery throws the burden of supplying an adequate amount of arterial blood for the viability of the extremity on the collateral circulation. The collateral anastomoses increase from day to day. There is therefore a critical period in which the blood supply may be inadequate and gangrene develops before a collateral circula-

tion develops. Our experiments indicate that the risk of gangrene may be decreased by producing a certain amount of venous occlusion at the time the artery is ligated, by ligating the accompanying vein also. This procedure in all probability is beneficial because of the fact that it increases intravascular tension, and thus leads to a more homogeneous distribution of the blood. The ligation of the vein, actually decreases the volume flow of blood. It is important therefore not to produce so much venous obstruction as to decrease the volume flow below that necessary for the life of the extremity. The principle of simultaneous ligation of vein and artery, as first advocated by Sir George Makins is therefore applicable in certain instances, and I believe it should be used if the ligation is at such a point as to endanger the extremity and there is not already present evidence of venous stasis.

In 1925 McNealy³² taking for his thesis that the clinical and experimental literature showed definite evidence of improved results after simultaneous ligation of vein and artery, attempted to explain these results on purely theoretical grounds with the aid of the literature up to that time. He did not offer any new clinical or experimental evidence in support of his arguments. He favored simultaneous vein ligation, but said that it must be so selected that it would serve only to restore circulatory equilibrium and must not result in too great a drawing back of blood. How this is to be accomplished is not stated. In discussing the work of Brooks and Martin he brought out the following point: "They point out that the simultaneous occlusion of the vein has been thought to bring about a wider distribution of blood. As a result of their experiments they leave one in doubt on that point since their experiments in which the temperature of the tissues was used as a criterion contradict that theory." This criticism is not valid, because the temperature is dependent not on the amount of blood or its distribution, but on the minute volume flow through the limb, which Brooks and Martin declare to be reduced.

In 1925 Harvey and Ferris³³ reported

some interesting temperature determinations from the deep tissues of dogs' feet after ligation of the femoral artery, having

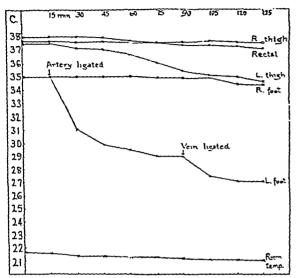


Fig. 2. Temperature changes of extremities following ligation of primary artery of extremity and subsequent ligation of corresponding vein. (From Brooks and Martin.³⁰)

a bearing on this point. Their curve was constructed from continuous readings from a thermocouple and galvanometer for a period of seventeen hours. The temperature on the ligated side, after a preliminary rise after four hours of observation, fell to almost room temperature during the next eight hours, and then was followed by a sudden rise to normal, thereafter maintained. In the light of these experiments it could be seen that the temperature experiments of Brooks and Martin (Fig. 2) did not tell the whole story as they did not cover a long enough period of time, the longest being six hours. Also the further temperature drop which they attributed to ligation of the vein would come in the period when the temperature of the limb was still falling as a result of ligation of the artery according to the curve of Harvey and Ferris.

Holman and Edwards^{34,35} introduced in 1927 what they called a new principle in the surgery of the large vessels, the principle of ligation of the accompanying vein proximal to the site of the ligation of the

artery. Their advocacy of this principle was based on three types of experiments:

1. They found that the blood pressure

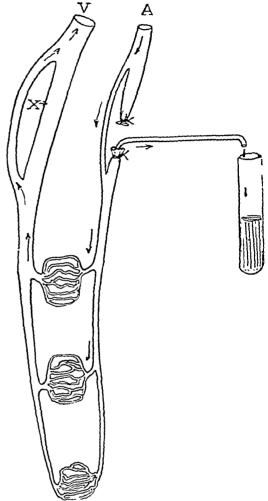


Fig. 3. Experimental method used by Holman to determine effects of ligation of vein on volume flow of blood through extremity. It is obvious that obstruction of vein at X would result in more blood flowing through cannula. The fact that more blood flows from cannula is not an indication of increased volume flow of blood through capillaries, but is evidence for truth of contrary conclusion. (From Brooks.³⁶)

taken by cannula from the distal end of the divided femoral artery was increased 5 to 10 mm. Hg when the femoral vein was occluded; 14 to 20 mm. Hg when the common iliac vein was occluded, and 24 to 28 mm. Hg with occlusion of the vena cava.

2. The flow from the distal end of the divided femoral artery was taken as a fair index of the volume of blood passing

through the extremity distal to the point of division. This flow was increased 2 c.c. per minute by occlusion of the femoral vein, 10.6 c.c. by occlusion of the common iliac, and 11 c.c. by occlusion of the vena cava.

This experiment is based on the false assumption that the flow from the distal end of the divided artery represents the volume flow of blood through the peripheral portion of the extremity as demonstrated by Brooks³⁶ in a later paper. While Holman and Edwards consider their experiment as an evidence of increased volume flow through the limb, Brooks shows by a simple diagram (Fig. 3) that obstruction of the vein results in an obstruction of the outflow of blood from the limb and a corresponding increase in the intravascular pressure, and would thus be an evidence of diminished rather than increased volume flow through the peripheral tissues.

3. They ligated the right iliac artery just proximal to the hypogastric, and the vena cava simultaneously 3 cm. above the confluence of the iliac veins in 18 rabbits, and 2 cases of gangrene developed. In 10 other experiments the iliac artery was ligated proximally and distally to the hypogastric, and the vena cava simultaneously proximal to the first large venous tributary, and no gangrene resulted.

Thus, there are 2 cases of gangrene out of 28 animals or a percentage of 7.1. These results they compare with the 33.3 per cent gangrene reported by Brooks and Martin³⁰ following simultaneous ligation of the vein and artery at the same level. Their conclusions on this angle of the subject would have had more weight if they had run their own series of control animals, ligating the artery alone, as Brooks and Martin did. As a matter of fact, only ten of the experiments done compare in any way with the method of ligation of Brooks and Martin, and there may have been differences in the animals, or technique.

Pearse³⁷ in 1927 reported results of experiments to determine the advantage

of simultaneous ligation of artery and vein versus ligation of artery alone in opposite limbs of the same animal. He found that the residual arterial pressure distal to the ligature when the vein was ligated at the same level was 11 mm. Hg; after one week this had decreased to 8 mm. Hg and after three weeks there was no longer any increase. Though he states in his summary that there was an increased blood volume flow, he does not state the method of measuring this except to say that it was obtained from the femoral artery, and thus it is probably open to the same criticism that Brooks made of Holman and Edwards' method; furthermore, there are no actual readings given in his statement of results on which he bases his conclusions. He found by taking x-rays of the injected circulation at various intervals after ligation, that the vascular bed in the limb having the artery and vein ligated was much richer than the limb having only the artery occluded with the maximum difference at the end of two weeks. Brooks³⁶ had this to sav regarding these experiments:

It is worth while, however, to call attention to the fact that the size of blood vessels as determined by injection is not a reliable index of the actual volume flow of blood through the tissues and also to the fact that the condition of the circulatory bed three weeks after a sudden arterial occlusion is not necessarily important in the study of the cause of gangrene.

To which we may add that variations in the pressure of the injections will modify the results also.

In 1928 Theis³⁸ reported the results of his experiments on the minute volume flow of blood, and the roentgen appearance of the vascular bed at various intervals after ligation of the artery and vein, as compared with ligation of the artery alone. Ligation of the common iliac vein caused an increase in the volume flow from the distal end of the ligated superficial femoral artery, which, however, was only transient, and the volume flow at the end of one hour

TABLE 1

					I ABLE I				
Reported	Operator	Date of	Age	Sex	Indication for	Artery Ligated	Congress Fatant	A	mPutation
Reported	Operator	Operation	Age	Sec	Ligation	Artery Ligated	Gangrene Extent	Day	Location
1 Martin, A. A. Brit. M. J., Jan. 17, 1903.	Martin	Nov. 23, 1901	31	M	Ancurysm of l. ext.	Left comm. iliac	0 0	0	0
² Maynard, F. P. Indian M. Gaz., p. 253, 1903.	Maynard	Apr. 20, 1903	32	M	Ruptured ilia c	Rt. com. iliac	0 0	0	G
3 Dreist, K. Deutsche Zeit. F. Chir. LXXI: 5, 1904.	Czerny	Feb. 26, 1897	28	M	Slight hem, in course of operation	Left comm. iliac	0 0	0	0
4 Dreist, K. Deutsche Ztschr. Chir, 71: 5, 1904.	Trendelenburg	Oct. 4, 1898	60	М	Dissecting aneu- rysm of comm. iliae	Lest comm. iliae	0 0	0	0
5 Dreist, K. Ibid.	Von Christel	Mar. 6, 1901	28	M	Hem. foreign body around femoral	, Left comm. iliae	+ Upper and mid. 15 of leg	+	Upper leg
6 Dreist, K. Ibid.	Ernst Kuster	Jan. 7, 1898	17	F	Elephantiasis	Rt. femoral	0 0	0	0
	Ernst Kuster	Mar. 18, 1898	17	F	Elephantiasis	Rt. ext, iliae	0 0	0	0
(Same patient)	Ernst Kuster	Jan 26, 1898	17	F	Elephantiasis	Left femoral	0 0	0	0
	Ernst Kuster	Jun. 23, 1898	17	F	Elephantiasis	Left comm. iliac	0 0	0	0
7 Hickson, L. J. Roy. Army M. Corps, 2: 23, 1904.	Hickson	July 17, 1900	40	M	Fem. art. vein an- eurysm Hunter's canal	Fem. art. & vein quad. lig. & ex- cision		0	'
8 Hickson, L Ibid.	Hickson	May 12, 1900	32	M	False aneur. bullet wound	Sup. fem. lig. above & below excision	0 0	0	0
9 Hickson, L. Ibid.		Nov. 10, 1900	30	M	Hem. for bullet wound of sup. fem.	Fem. art. in Scar- pa's Δ	+ Foot deep ulcers of leg	, +	Mid-thigh
10 Hickson, L. Ibid.	Hickson	Mar. 28, 1902	?	M	False aneur. bullet wound of fem.	Sup. fem. at base of Scarpa's Δ	0 0	0	0
11 Isambert & Petit. Arch. de med. & rharm. Mil., 43: 121, 1904.	Isambert	Feb. 6, 1903	30	М	Aneyrysm following knife wound	Fem. above & be- low wound & the profunds		0	0
12 Smith, A. C. J. A. M. A., 43: 813, 1904.	A. C. Smith	June 24, 1904	30	M	Aneurysm of rt.	Rt. external iliac	0 0	0	0
13 Clark, H. G. Brit. M. J., p. 850, 1905.	Clark	May 20, 1905	26	M	Knife wound of profunda 25 days?		0 0	0	0
14 Cranwell, D. J. Rer soc. med argen., 14: 338, 1906.	Cranwell	Feb. 28, 1904	48	M	Aneur. of iliac & fem. arts.	Rt. comm, iliae	+ Mid 15 of 2nd leg	+ 2nd	Mid-thigh
15 Rustin, F. West. Med. Rev., 11: 184, 1906.	Rustin	Apr. 22,	Adult	M		Sup. fem. 2 in. be- low profunda	0 0	0	0
16 Guinard, A. Bull. & mem. Soc. de Chir, de Paris, 32: 999, 1906.	Guinard	Oct. 9, 1906	17	M	Hemorrhage from knife wound	Fem. art. & vein Mid-thigh	+ "Muscl. 40th Jambier day anterieur"	0	0
17 Hutchinson, J. Lancet, 1: 1388, 1906.	Horne	Sept. 1 1905	22	M	Knife wound of femoral art. & vein	Common femoral and vein	+ upper 15th part of day patella	15th	Mid-thigh
18 Nydegger, J. A. Ann. Surg., 44: 95, 1906.	Nydezger	N.S.	52	M	Aneurysm in groin	Left external iliae	0 0	0	0
		1			ļ 				

TABLE 1 (Continued)

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	Death	a		
Day	Cause	Complications	Collateral Circulation Indications	Remarks
0	0	Large ancurysm of external iliao	Wrapped in cotton wool and bandaged 3 days after operation left leg still colder; no feeling, blanched, toes edematous. No pulse	One week later after operation temperature of both feet nearly same. 21/2 months later was O.K.
6th	Diarrhea and vomiting	Large iliae aneurysm, ruptured; diarrhea; bronchitis	"Circulation of extremities not manifestly affected by operation"	No post mortem
5 mos.	Acute miliary Toc.	Small branch torn off during operation for tuberculous lymph glands	"Left extremity somewhat cold during first two days"	
3 hrs.	Hemorrhage	Wretched general condition		
0	0	Emaciated, anemic. External iliac ligated above & below epigastric	"Aftera time leg became cold and insensible"	***************************************
0	0	None	Limb became paler after operation	
0	0	Rt. femoral previously ligated	No observations)
0	0	Rt. femoral previously ligated	No observations	l
0	0	Left femoral previously ligated	Limb cooler toward eveing. Temperature of both legs same on 4th day	
0	0	Artery-vein aneurysm—4 months' duration	"There was neither loss of temperature in the limb nor edema"	Complete recovery
0	0	False aneurysm—I month	"There was never any loss of heat in the leg	Complete recovery
0	0	Large effusion of blood into tissues of thigh	At first collateral circulation appeared well established. "Gangrene no doubt resulted from pressure exerted by fibrous clots on the collateral circulation	
0	0	Large clots in tissues of thigh (removed at operation)	"Patient made an uninterrupted recovery"	ı
0	0	Ancurysm—3 weeks	No trouble in the leg below the ligature	1
0	0		Natural temperature restored the following morning. Leg swathed in cotton & bandages & hot water bottles	
0	0	Infection. Repeated hemorrhage. Profunda and common femoral previously ligated	No immediate observations	,
0	0	Popliteal ancurysm—4 months duration	Application of heat to leg slightly above body temperature. 24 hrs. after operation the foot was comparatively cool, and remained that way for 3 days	
36th	Arteriosclerosis; sacral decubitus, gangrene	General arteriosclerosis. Great edema of thigh and legs	Next day leg was livid and without sensation, calf to toes	
0	0	Exsanguinated	The next day did not observe anything wrong with foot or leg which was kept wrapped in cotton	The gangrenous muscle of the lower leg was removed entirely and recovery followed
0	0	Pulseless from hemorrhage. Artery & vein severed; both tied	Discoloration to 3 in. below knee noted on 3rd day	
0	0		At first there was noticeable discoloration which gradually disappeared. Leg surrounded by cotton & hot water bottles for 2 days	Leg surrounded by cotton and hot water bottles for 2 days

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Table 1 (Continued)

	Death	Complications	Collateral Circulation Indications	D1
Day ,	Cause	1	<u> </u>	Remarks
0	0	Left internal iliac ligated 7 months previous, Aneurysm left. Sciatic—Left external iliac ligated at same operation	No statements	
0	0	Deep epizastric and deep circumflex iliac ligated at same time	Discomfort & numbness in leg. No immediate observation. Cotton & hot water bottles for several days	Cotton and hot water Lottles for several days
0	0	Infected wounds	Evening of same day toes were warm and pink; next day slight femoral pulsation. 3rd day D.P. pulse palpble	
0	0	Hemorrhage from wound	Limb kept warm with hot water bottles. No other observations	
30 las.	Postop, shock	Oozing from malignant mass at Scarpa's Δ. Another large vessel coming from lumbar region was lig. tumor removed	24 hrs. postoperative right leg was mottled and cold from toes to hip	This case apparently not included in Halsted's series
0	0	Aneurysm of left common femoral	Limb wrapped in cotton wool and blanket. Feeble post tibial pulse 8th day	
0	0	Large ancurysm of left external iliac	After operation left foot seemed cooler than right, but was of good color and no impairment of sensation. At midnight slight bluish tinge to skin lasting 2 hours	
0	0	Quadruple ligature of femoral artery & vein	Immediately leg seemed blanched, 4 hrs. later had sensation of tingling and feeble capillary circulation under nails	
0	0	Quadruple ligature above and below aneurysm	"Rapid, uneventful recovery." Has no right femoral or popliteal pulse, but has D.P. pulse	
0	0	Hemorrhage from wound 5th day, Ligated above only	Collateral circulation established previous to ligature. Uneventful recovery	
0	0	Artery & vein ligated above and below and sac excised	Leg elevated and surrounded with cotton. No difficulty	
4 mos.	Pulmonary tuberculosis	Ligated above and below a bullet wound	No immediate observations	
0	0	Aneurysm of rt external iliac, 7 yrs, duration	"Satisfactory recovery"	
0	0	Quadruple ligature with extirpation of intervening segments	No immediate observations. Ultimate recovery	
0	0	Quadruple ligiture with extirpation of intervening segments. Both for femoral A-V aneurysm	No immediate observations. Ultimate recovery	
32 hrs.	Gas gangrene	Hemorrhage from grenade wound	The whole right leg was white, gelatinous, insensible	
0	0	False aneurysm of lower femoral from wound 10 days previous	No immediate observation on circulation of limb. Complete recovery	
0	0	Quadruple ligature of artery and vein with resection. Infected wound	No immediate observations. Ultimate recovery.	
0	0	2nd operation Feb. 13, to pack aneurysmal sac 3rd operation Feb. 16, ligature of deep epigastric artery and vein	Feb. 3 leg quite warm, slightly pale. Feb. 17 good, March 16 good. June 4, no difference in legs.	
0	0	War wound, Patient almost dead	"Foot in critical state for 2 days, then cir- culation improved"	
0	0	War wound. Thigh swollen. Foot cold	Circulation returned in a few hours. Condition of foot never doubtful	
0	0	Hemorrhage and shock	End of operation leg was cold and cyanotic. Warm H ₂ O bottles, 7 hours leg warmer and better color. Next day, warm and of good color. Recovery	
0	0	Second hemorrhage complicated fracture 25 day previous. Osteomyelitis	"The leg remained always warm"	

***************************************				~ 2>2.2.	1 (Communes)			 		
Reported	Operator	Date of Operation	Age	Sex	Indication for Ligation	Artery Ligated	Gangrere	Extent	Day	Iocation
42 Sertorio, M. Hid.	Sertorio	1	Adult	M	Prim. Temerr. of poet, thal revels		0	0	; 0	0
43 Davidson, C. F. J. A. M. A., 73: 269, 1919.	Davidson	Feb. 22, 1910	. 15	M	Puncture wound	External iliae	0	0	0	0
44 Davidson, C. F. Ilid.	Bergman			M	Traumatic angu-	External iliac	0	0	, 0	0
45 Greibel, E. Deutsch Ziechr Chir., 155; 312, 1920.		1913			Areuryem of corom.	Common ilian	0	0	, 0	0
46 Fallis, W. E. Ken'ucky M. J., 19: 281, 1921	Fallis	1920	17	М	Sec. Jemor. bullet wour lin art.	Fem. art. above & below wound	0	0	0	0
47 Bell, G. M. J Australia, 1: 189, 1921.	Bell	July 14. 1920	15	М	Wound .	Left comm, fem	0	0	, 0	0
48 Ellars, L. R., Am J. Surg, 35: 214, 1921.	Ellars	April 1, 1920	20	М	Wound	Left common fem.	0	0	, 0	0
49 LaRoque, G. P. Ann. Surg., 63: 265, 1921.	LaRoque	Aug. 25, 1920	22	М	Gunshet wourd	Ext. s'incart & vein		ntar sur- of 3 tom	0	0
50 Priest, J. Missouri M. A., 18: 463-1921	Brooks	May 10, 1921	40	F	Arrunsm of ext	It comm that	0	0	0	0
51 La Reque, G. P. Ann. Surg., 75: 705, 1922.	LaRoque		25	F	Gunshot wourd	Fem. below pro- funda d vein	0	0	0	0
52 Dodd. J. M. J. A. M. A 79: 1245, 1922.	Dodd		25	М	Metal rod wound Hemorrhage	Femoral	0	0	0	0
53 Grover, C. P. & Fisher, D. Ann. Surg., 78: 84 1923	Grover	June 27, 1922	29	М		Femoral artery &	0	0	, 0	0
54 Hansen, R. N. Acta Chir Scandinar, 58: 405, 1925	Han-en	***	. 27	r	Bilat femoralancu rysm	2 ext.iliac bilat	0	0	0	O
55 Hansen, R. N. Ibid.	Hamen		23	M	Hemorrhage from bullet wound	Femoral (lower) art.	0	0	0	0
56 Hansen, R. N. Ibid.	Hansen	1	1 20	M	Hemorrhage from thigh wound	Femoral art.	0	0	1 0	0
57 Thompson, J. E. Texas State M. J., 21: 15, 1925		Aug 16, 1915	30	M	Aneuryem of 1.	Lest common iliac	0	0	, 0	0
58 Thompson, J. E Ibid.	Singleton	S-pt 21, 1922	27	M	Aneuryam of 1 ext.	Lest comm iliac	0	0	0	0
Thompson, J. E. Ibid.	Thompson	Sept. 21, 1922	27	М	Aneuryam of left internal iliae	Left femoral above profunda	0	0	0	0
59 Haggard, W. D. Tera: State M. J., 21: 21, 1925	Floyd	1	30	M	A-V. aneurysm of ext. iline	Rt ext. iliae art. & '	0	0	0	0
60 Lewis, Dean & Reichert F. L. J. A. M. A., 87: 5 302, 1926.		Apr. 10, 1926	67	М		Rt. femoral below profunda	0	0	0	0
61 Neill, T. E. Ann. Surg. 86: 425, 1927.	, Neill	Oct. 25, 1926	59	M	Endartentis oblit- erans with gan- grene			es present re oper- ition	0	0
62 Junken, H. D. Northwest Med., 26: 36, 1927.	Junken	Apr. 25, 1925	12		Bullet wound	Rt. comm. fem.	0	0	0	0
63 Barbier, Guilleminet & Pouzet. Lyon med., 139 236, 1927.	M. Berard	June 23, 1926	16	М	Subcutaneous rup- ture	Rt. ext. iliae	0	0	0	0
64 Bessesen, A. N. Jr., Besse sen, D. H. M. J. & Rec. 127: 547, 1928.			23	F	Hemorrhage ab- dom, pregnancy	Left common iliac	0	D	0	0

TABLE I (Continued)

	Death 1		SLE I (Continuea)	
Day ,	Cause	Complications	Collateral Circulation Indications	Remarks
0	0	Hemmhorage from laceration and contusion post, tibial vessels	"This case showed no appreciable disturbance of nutrition, sensibility or movement	
0	0	Patient in precarious condition from hemorrhage	Immediately leg became purple and enlarged. In 2 hours, 10 minutes, pulse of post-tibial felt. Leg normal color and size in few hours	
0	0		"Collateral circulation established in one hour and 10 minutes	
+?	Perforated duodenal ulcer	Aneurysm and hole in common iliac size of penny. Common iliac resected between 2 ligatures	Pulse appeared in femoral artery after removal of aortic clamp	Wound became infected
0	0	Hemorrhage	After 24 hours pulse at ankle and color of toes reestablished, though foot colder than other for 6 or 7 days	
0	0	1.9 cm. artery resected between two ligatures	No coldness, nor signs of failure of circulation. No post-tibial pulse Aug. 15, 1920. Well marked pulse Nov. 3, 1920	Wound in vein closed by lateral ligature
0	0	Gunshot wound. Shock	No immediate observations	Leg wrapped in cotton. Later ischemic myositis cured by tenotomy
0	0	Immediate operation Quadruple ligature with excision	Next day foot and limb sweating. No pulse 16 weeks later	Leg wrapped in cotton and surrounded by heat
0	0	Aneurysm of external iliac, 6 years duration	Pulsation in sac returned before patient left table. No other observations	ı
0	0	Quadruple ligature with resection	No immediate observations. No palpable pulse in 3 weeks, otherwise normal	Leg surrounded with abundance of heat
0	0	Hemorrhage 6 days after thigh wound. Excision between ligatures	Kept warm. "Sufficient collateral circulation to sustain its vitality"	
0	0	Quadruple ligature of artery & vein with resection	No immediate observations. 3 weeks later, no peripheral pulses, but leg appeared nor- mal	Authors recommend simultaneous artery & vein ligature
214 mos.	Operation on ab- dominal aneur.	Spontaneous bilateral femoral aneurysm, Severe heart disease	After operation legs warm and appeared nor- mal to sight and touch	
0	0	12 days after bullet wound. Lateral ligature of vein. Ligature of artery above & below wound just above popliteal	No immediate observations. Pulse in popliteal and tibial artery weaker than other side. Leg otherwise normal	
0	0	Hemorrhage, Ligature above and below thigh wound. Sharp instrument	No immediate observations. Two days later anterior tibial pulse felt, but feebler than other side	
1 yr.	Recurrent aneurysm	Large common iliae ancurysm	No immediate observations. Few days later sac begun to pulsate and in 2 weeks pulsated strongly as before ligature	
0	0	Aneurysm of left external iliac	No immediate observations. "Circulation in thigh and leg good at end of 1 month"	
0	0	Aneurysm of left external iliae bleeding from puncture of the sac	Circulation in leg never embarrassed at any period	
0	0	Aneurysm. Ligated above and below	"Uneventful recovery"	
0	0	Thrombo-angitis obliterans with pain and ulcer of right heel	"No signs of gangrene followed ligature of artery"	
36th	Sudden death. Pulm, embolus?	Endarteritis obliterans with necrosis of distal phalanges of toes	Steady improvement in circulation and sub- sidence of gangrene	
0	0	Bullet wound, Shock, Typhoid on 25th day	Immediately extremity was cold, mottled, and had less sensation. Radiant heat applied	
0	0	Subcutaneous rupture. Operation 20 hours after accident	Foot white and cold for one week, gradually lessening. No pulses in foot 4 mos. later	
0	=	Pulseless from hemorrhage from abdominal pregnancy	Left leg numb for while, 2 mos, later attended dances	

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Common iliac	/ Male. Female		o o	0	ı 0	0	11	0	t) t)	3	5	0	1	r o	7 D	7	o o	9	3 0	0	D 1		2	1 D	2 0	ti D	2	. J.
Common ibac artery & sem	Male Female		0	0	0	0	00	0	Ö	0	0	0	0	o c	0	0	0	 0	0	0	21		o 0	0	21	31	7) D	1 : D
External iliac artery	Mule Femule		0	0	0	0	00	0	0	00	0	0	0	о о	0	0	0	0	0	o o	0 2	*	0	0	0	o o	0	9 I.
External ilien artery & sein	Mule Femule		0	9	0	0	00	0	0	-D	0	0	0	0	v v	0	D	0	0	t) 0	00		 ຍ ຍ	D D	9	D D	ນ ຄ	D 3
Common femoral artery	Male Female	• • •	0 0	1	1	0	00	0	7 1	3 0	0	0	1 0	o o	0	o o	0	0	1	0	0 5	,	อ ช	0	°	о о	0	7 17
Common femoral artery A vein	Male Female	***	0	0	7	0	00	0	0	0	0	0	1	0	0	9 0	0	0	ກ ບ	0	00		o o	න ව	9	9 0	0	p :
Superficial femoral artery	Male Female	· · ·	0	0	0	ص ه ه	7 t 0	0	v 0	ュ カ	صــ و ه	_ ວ ວ	0	• •	о О	т о	かか	0	0	0	00		 10 10	о 0	j D	э э	о О	3 37
Superficial femoral arters & ven	Male Femile		0	1	0	0	00	0	 1	- 2 0	ວ ວ	0	0	0	0 0	0	9 9	v 0	0	0	0 0 0 0		 5 5	0	0	0	0	0 : 0
	······································		0	2	 3	0	1 2	 0	 2	10	 p	0	 3	 ن	7	1	0	 v	 5	70	5	 3	3	2	3	t)	3	22 5

^{*} Bilateral ligation

was not any greater than when the artery alone was ligated. The volume flow from the distal end of the ligated artery does not represent the minute volume flow through the periphery of the limb, as previously pointed out in regard to Holman and Edwards' work. At the same time even with this method he failed to confirm Holman's findings. In direct contradiction to Pearse's roentgen findings, Theis found that the vascular bed was better immediately after ligation of the vein and artery. but that three weeks later the vascular bed was more developed were the artery alone was ligated.

Brooks in 1929 summed up the situation in this manner:

(1) All observers agree that ligation of the concomitant vein in the presence of simple arterial obstruction raises the blood pressure in both the veins and the arteries distal to the obstruction. (2) Both experimental and clinical experience indicates that the incidence of gangrene is diminished. (3) In the attempts to explain the beneficial effects of therapeutic venous occlusion without arteriovenous fistula is found the confusion of ideas.

He then expresses his views on the difference in therapeutic venous obstruction as applied to the treatment of arteriovenous fistula, and to simple arterial obstruction. His own clinical experience leads him to believe that venous occlusion of an amount sufficient to be of value in the prevention of gangrene is often followed by manifestations of venous stasis from which convalescence is prolonged or incomplete. He concludes that simultaneous ligation of the vein is not to be considered the preferable procedure in all arterial ligations. It is to be applied only in those in which without ligation of the vein gangrene would be expected. He thinks simultaneous vein ligation is indicated in ligation of the popliteal or axillary arteries; that it makes little or no difference in ligature

T Present before limition

TABLE III INDICATIONS FOR LIGATION

	Arterio- venous Ancurysm	Aneurysm	Hemor- rhage	Elephan- tiasis	Malig- nancy	Hemorrhage Abdominal Pregnancy	Oblitera- tive End- arteritis	Total
Common iliae	0	, I I	1 2	1		•	0	17
Common iliae artery &	v	1		! -		1		
vein	0	0	T	o	o	0	0	i I
External iliae	0	7	2	ľ	0	О	О	14
External iliac & vein	2	. 0	1	, o	0	О	o	3
Common femoral	0	' I	9	2	o	o	O	12
Common femoral & vein-	3	o	3	' О	0	0	О	8
Superficial femoral	I	1 4	3	0	0	0	2	10
Superficial femoral & vein	0	0	4	o	0	0	0	4
,	8	23	30	4	1	I	2	69

Number of cases—64 Number of ligations—69

TABLE IV GANGRENE CASES

Case No	Operator	Artery Ligated	Age	Sev	Indications	Complications	Amount of Gangrene	Ampu- tation
14	Cranwell	Right com-	48	M	Aneurysm of iliae & femoral arteries	General arterioselerosis Great edema of thigh and leg	Mid ½ of leg	+
5	Von Christel	Left com-	28 1	M	Hemorrhage from foreign body wound of femoral	Emaciated, anemic. Iliae ligated above & below epigastric	Junction upper and mid ¹ / ₃ of leg	+
10	Gillette	Left com-	56	M	Ancurysm of left sciatic artery	Left internal iliac ligated, 7 months previous. Left external iliac ligated at same time	Junction upper and mid 1/3 of leg	+
34	Masnata	Common femoral	Adult	M	Primary hemor- rhage grenade wound	Hemorrhage from grenade wound	Whole leg. Gas gangrenc	Died
ŋ	Hickson	Common femoral	30	M	Primery bullet wound, Superficial femoral	Large effusion of blood into	Foot. Deep ulcers of leg	+
16	Guinard	Superficial femoral	17	M	Primary hemor- rhage knife wound	Exsanguinated	Anterior leg muscle only	0
61	Neill	Superficial femoral	59	M	Obliterative endar- teritis with gan- grene	Obliterative endarteritis	Necrosis of toes present before operation	0
48	Ellars	Common	20	M	Gunshot wound	Gunshot wound, shock, hemorthage	Plantar surface of 3 toes	0
39	Cowell	Superficial femoral artery and vein	Adult	M	Wound through thigh	Gunshot wound. Patient almost dead	Tips of toes	0
16	Hutchinson	Common femoral artery and vein	22	M	Hemorrhage from knife wound of femoral artery and vein	Pulseless from hemorrhage	Upper part of patella	+

TABLE V

Case No.	Operator	Artery Ligated	Age	Sex	Indications	Complications	Time of Death	Cause of Death
23	Lanphear	Right common iliae	N.S.	N.S.	Oozing from malig- nant mass	Oozing from malignant mass at Scarpa's tri- angle. Another large vessel coming from lum- bar region was ligated. Tumor removed		Postoperative shock
45	Greibel	Common iliae		••	Aneurysm of com- mon iliac	Aneurysm and hole in common iliac size of penny. Resected be- tween 2 ligatures		Perforated duo- denal ulcer
54	Hansen	External iliac	27	F	Spontaneous bilateral aneurysm of femoral arteries	Severe heart disease	2} s months	Operation on ab- domen. Aneu- rysm
61	Neill	Superficial femoral	59	M		Obliterative endarteritis with gangrene	36 days	Sudden death. Pulmonary em- bolus
57	Thompson	Left common iliac	54	M		Large common iliac aneu- rysm	1 year	Recurrent aneu- rysm
30	Orth	Common iliae artery and vein	22	M	Bullet wound	Ligated above and below bullet wound	4 months	Pulmonary tu- berculosis
34	Masnata	Common fem- oral	Adult	М	Hemorrhage. Gren- ade wound	Hemorrhage from gren- ade wound	32 hours	Gas gangrene
2	Maynard	Common iliac	32	M	Ruptured iliae aneurysm	Large iliac aneurysm rup- tured, diarrhea, bron- chitis	6 days	Diarrhea and vomiting
3	Czerny	Common iliac	28	М	Slight hemorrhage in course of opera- tion	Slight hemorrhage from small branch torn off during operation for tu- berculosis gland	5 months	Acute miliary tuberculosis
4	Trendelenburg	Common iliac	60	M	Dissecting aneu- rysm of common iliac	Wretched general con- dition	3 hours	Hemorrhage
14	Cranwell	Common iliae	48	М	Aneurysm of iliac and femoral arter- ies	General arteriosclerosis. Great edema of thigh and leg	36 days	Arteriosclerosis, sacral decubi- tus, gangrene, amputation
		•	•	•	·			

of the femoral or brachial arteries; and that in ligating the common femoral artery it is wiser to leave the accompanying vein unoccluded unless signs of impending gangrene develop later.

In order to obtain some idea of the results following ligation of the large arteries of the lower extremity in man, a careful compilation was made of all the individually reported cases of ligation of the common and external iliac, and common and superficial femoral arteries in the

literature from 1900 to January 1930. (Table 1.) This did not include statistics of groups of cases reported without individual data as to complications, amount of gangrene, or cause of death. The significant data from this study have been condensed into 4 tables. There was found a total of 69 ligations performed in 64 cases (some were bilateral). Table 11 shows the age incidence for each of the arteries ligated. Table 111 shows the indications for ligation. In Table 11 to cases of the group that developed

gangrene are analyzed. The incidence of gangrene in the 69 ligations was 10 cases, or 14.4 per cent. In some of these the account of other complications which might influence the occurrence of gangrene, the percentage would more nearly approach

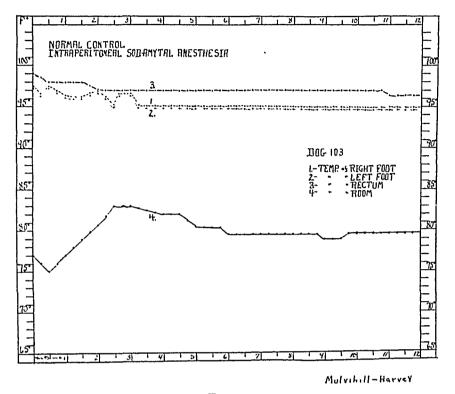


Fig. 4.

amount of gangrene was very small, and in Neill's case of obliterative endarteritis, necrosis of the toes was already present before the ligation. Only 5 cases or 7.7 per cent of 69 ligations required subsequent amputation. Death followed in 11 cases, or 15.9 per cent of 69 ligations as shown in Table v. In 4 of these cases the deaths occurred from five months to more than a year after the ligation, and from causes not directly connected with the operation. In I case death two and one-half months later followed a second operation on an abdominal aneurysm. Therefore, the number of deaths which might be considered to be due directly or indirectly to the ligation are reduced to 6, or 8.69 per cent.

This study of the literature would seem to indicate that the incidence of gangrene following ligation of the large arteries of the lower limb in man is not as high as generally supposed. The total incidence of gangrene in this collection of cases is 14.4 per cent, and if cases were excluded on

the 6.6 per cent given by Halsted³⁹ as the incidence of gangrene in ligations of the common iliac artery.

METHOD

Our own experiments consist of temperature measurements in the deep tissues of the periphery of limbs of dogs. The temperatures were taken continuously by means of thermocouples inserted in the central footpads of both feet, and into the rectum, and another exposed to room temperature, and recorded on an automatic recording potentiometer as previously described by us.1 This instrument automatically prints a temperature reading from each of the 4 thermocouples every four minutes, and from these readings the graphs are constructed. The instrument is accurate to within 0.5° F.

For the experiments seven dogs were used. For anesthesia amytal was found to be most satisfactory in previous experiments in this laboratory. This is prepared

in 10 per cent solution in half-normal sodium hydroxide, according to the directions given by the manufacturer. Injections

of an aneurysm needle and tied tightly. The accompanying vein was then ligated at the same level. The tissues were then

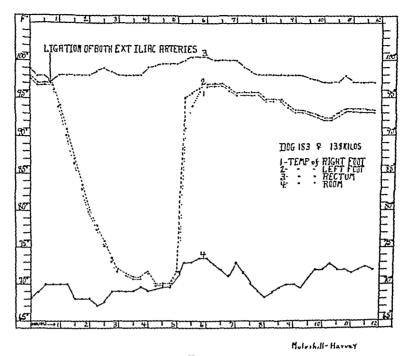


Fig. 5.

were given intraperitoneally in dosage of 55 mg. per kilogram of body weight. The animals were usually under anesthesia within ten minutes after the administration of the drug, and remained under complete anesthesia throughout the duration of the experiment with little, if any, effect on the temperature of the body or extremities, as is shown by the control (Fig. 4).

After a sufficient time had elapsed to obtain normal readings, we proceeded with the ligation of the arteries and veins. The operative procedure was the same in all animals. An incision 2 in. long was made through the skin and superficial tissues along the external border of the rectus muscle. The edge of the rectus muscle was retracted medialward, and the peritoneum pushed toward the midline, exposing the external iliac artery above the first large branch (the inferior epigastric). The sheath of the artery was split longitudinally for a distance of 1.5 cm. and a double silk ligature passed around the artery by means

allowed to fall back into place, and approximated with two layers of No. o catgut, and the skin closed with subcutaneous suture of black silk. Great care was taken to preserve the small vessels and nerve filaments accompanying the large artery and vein. The procedure on the opposite side was the same except that the vein was not ligated. It should be noted that in the dog both the external and internal iliac arteries arise from the root of the aorta, there being no common iliac artery as in man.

This series of experiments is a continuation of our previously published series1 of results following ligation of the femoral, and external iliac arteries. A typical curve showing the temperature changes, and reestablishment of collateral circulation after ligation of the external iliac artery is included here for comparison (Fig. 5).

In order to conserve space, we are including only one typical curve of the experimental results. The graphs of results of similar procedures on all the other six dogs were practically the same. The curve (Fig. 6) shows that after ligation of the taneous ligation of the companion vein when it is necessary to ligate a large artery has led to a review of the clinical and

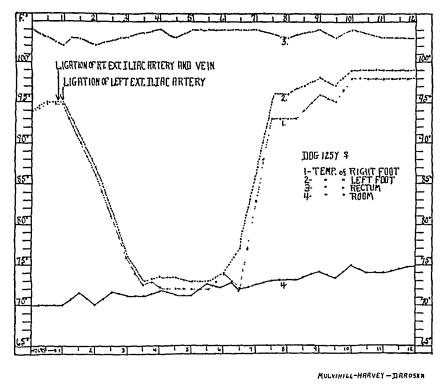


Fig. 6.

external iliac artery on one side, and the external iliac artery and vein on the opposite side the temperatures of both feet dropped gradually 22.°F. in a period of three hours to practically room temperature. Then after remaining at room temperature for about four hours it rose suddenly to 99°F., which was maintained thereafter. The greater part of this sudden rise in temperature took place in a period of twenty minutes, and seems to signify the establishment of collateral circulation by means of a vasomotor mechanism. However, it will be noted that there is practically no difference in the temperature curves of the two sides, and this was found to be true in all the other experiments. This curve also corresponds to the curve obtained by ligation of the external iliac artery as previously reported,1 and shown in Figure 5. In no case did gangrene develop in either extremity.

SUMMARY

Consideration of the problem of simul-

experimental literature and the presentation of our own experimental results. Review of the clinical literature leads us to believe that: (1) Most surgeons consider the incidence of gangrene of a limb following ligation of its main artery to be very high. Halsted did not concur in this view and made an elaborate analysis of all reported cases to prove his stand. Our own experience with dogs indicates that the incidence of gangrene in this animal following the uncomplicated ligation of the external iliac artery is rare. (2) Previous to 1916 every effort was made to preserve the accompanying vein in the belief that its occlusion increased the danger of gangrene. Since 1916 and the experience gained in the World War, this policy has completely changed, and many surgeons advocate the simultaneous occlusion of the accompanying vein when an artery is ligated to prevent gangrene and to aid in the establishment of collateral circulation. There are some discrepancies in the clinical statistics on which the advocacy of this

procedure is based. We have already considered the experimental data with which various authors attempt to establish the procedure on a sound physiological basis. In the light of our experiments here presented, and the previous experiments of Harvey and Ferrisaa in 1925, the earlier temperature experiments of Brooks and Martin⁵⁰ would seem to have been of too short duration to give an adequate idea of the effect of simultaneous vein ligation. Their experimental results on the incidence of gangrene in rabbits, however, are not disproved. On the other hand, Brooks^{ar} has questioned the conclusions of Holman and Edwards³⁴ based on the increased flow of blood from the distal end of the divided femoral artery, and we agree with him in this. Again, Holman and Edwards' comparison of their results on the incidence of gangrene in rabbits with those of Brooks and Martin is not conclusive because of differences in the methods of ligation. The contradictory results of Pearse³⁷ and Theis in regard to roentgen findings after ligation and injection will need further rechecking. So it would seem that the experimental literature does not provide any sound physiological proof that the procedure of simultaneous ligation of the accompanying vein either decreases the incidence of gangrene or aids in the establishment of collateral circulation when a large artery is ligated.

Our previously reported experiments¹ on establishment of the collateral circulation in the dog, lead us to believe that the incidence of gangrene following the ligation of the external iliac artery, at least in this animal, is small. Consideration of the statistics from reported cases in the literature from 1900 to 1930 of ligations of the iliac and femoral arteries strengthens the opinion that the incidence of gangrene in the human following the uncomplicated ligation of these vessels either with or without ligation of the companion vein is smaller than generally supposed.

Finally the results of our experiments here reported indicate that in seven dogs, the temperature curve showing the return of collateral circulation was no different whether or not the accompanying vein was ligated with the artery. Furthermore, there was no gangrene in either leg of any of these dogs.

CONCLUSIONS

1. Review of the clinical literature indicates a belief in the high incidence of gangrene in humans following ligation of the large arteries. Since 1916 many surgeons have advocated the policy of simultaneous ligation of the accompanying vein when a large artery was ligated. This procedure was thought to aid in the establishment of collateral circulation, and to decrease the incidence of gangrene.

2. The experimental literature does not furnish any definitely proved sound physiological basis for the procedure of simul-

taneous vein ligation.

3. Our experiments on seven dogs indicate that simultaneous ligation of the vein has no demonstrable effect in aiding or retarding the development of collateral circulation as shown by the temperature curve at the periphery of an extremity of which the main artery has been ligated.

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GAS BACILLUS INFECTIONS IN CIVIL SURGERY

A BRIEF DISCUSSION

WITH REPORT OF 7 CASES*

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NEW YORK

AS bacillus infection has been known T since 1853 when Maisonneuve described it under the name of "gangrene Foudroyante." Pirogoff, a few years later, described the same condition under the name of "acute gangrenous edema." In 1801 Welch and Nuttall isolated from the human blood one of the causative organisms; this is known to us as Bacillus welchii or bacillus aerogenes capsulatus. From this time until the World War our knowledge of this infection was little enhanced. The frequency of this infection among the war wounded activated further investigation as a result of which much valuable information was brought to light.

Welch's bacillus (bacillus aerogenes capsulatus) was regarded as the responsible infecting agent and Bull and Pritchett in 1017, with the above as a basis for their work, developed an antitoxin for Bacillus welchii. In their experimental work at the Rockefeller Institute, they found that their antitoxin acted as a specific, therapeutically, on animals injected with cultures of this bacillus. Also they found that the antitoxin was quite as efficacious as a prophylactic. With the hope that the problem of treatment and prevention of gas bacillus infection would be solved by this antitoxin, it was taken to France where it proved to be a failure.

French bacteriologists studying the wounds of gangrene learned that bacillus aerogenes capsulatus (which Vincent found in 82 per cent of cases) was in association with other bacteria. The following organisms were then identified as coexisting etiologic factors of prime import in the causation of gas bacillus infection:

- A. Pasteur's vibrion septique
- в. Weinberg and Seguin's Bacillus oedematiens
 - c. Bacillus histolyticus and sporogenes
 - p. Bacillus fallax
 - E. Vincent's Bacillus fusiformis
 - F. Bienstock's Bacillus putrificus
 - G. Other anaerobes
 - н. Bacillus coli communis
 - I. Pyogenic cocci

Thus it appears that the combined efforts or symbiosis of several species of bacteria are required to produce gas gangrene. Tissier showed in his experiments that gas forming organisms in themselves had little power to cause gas gangrene but when affiliated with other organisms the typical disease was quickly produced. The aerobic associates, which are frepyogenic organisms, probably function by utilizing the available oxygen in the tissues and also by diminishing the patient's resistance. In further study of the associated activity of bacteria in the production of gas gangrene, Weinberg isolated two varieties of gas gangrene bacilli, the saccharolytic and proteolytic groups.

The saccharolytic group metabolize sugars and fats of the muscle resulting in the formation of butyric acid. The presence of this group of organisms in the wound is characterized by the sour odor and the brick-red color of the muscle. This partial destruction of the muscle tissue prepares the way for the proteolytic group to complete the destruction. Their presence is characterized by the odor of putrefaction which is typical for gas bacillus infection.

Gas bacillus infection has for a long time been recognized as a source of danger in

^{*} The author wishes to thank Dr. Kirby Dwight for permission to use records of the cases on his service in Lincoln Hospital. Submitted for publication January 10, 1931.

war wounds but it is only in recent times that the same has been realized in civil practice. We feel that its incidence is frequent enough to merit consideration since at Lincoln Hospital we have had 7 cases in six years. Four of these cases terminated fatally, the three surviving ones had amputations done, two through the thighs and one at the shoulder. One of the fatal cases (B. O'M.) was treated with perfringens antitoxin. Peculiarly, the 4 fatal cases were admitted primarily for medical conditions. In 2 of these cases infection occurred about the site of hypodermic injection. Of the 3 that survived 2 were patients injured in street accidents and the third in a factory accident. It is of interest also to note that the surviving patients were all under twenty-five, whereas those who died were all over fifty.

CASE REPORTS

CASE 1. Bridget O'M., aged sixty-five years, a housewife, was admitted Jan. 17, 1927 for illuminating gas poisoning. She was unconscious on admission at which time a small abrasion of the lower right arm was seen. The next day an ecchymotic area surrounded the abrasion. The swelling increased and temperature rose to 102°F. Patient was promptly operated upon; multiple incisions were made; there was free escape of gas; cadaverous odor was present; brachial and antibrachial vessels were completely thrombosed. Following operation continuous wet dressings were applied. Temperature remained at 102°F. and pulse 120. Patient was given 2 doses of perfringens antitoxin intravenously (300 c.c. in all). Patient grew gradually worse and died about ten hours after operation. Vigorous stimulation and supportive treatment were without avail.

Case 11. Oscar L., aged seventy-five years, a retired man, was admitted March 14, 1927, for chronic myocarditis with acute cardiac decompensation. On admission temperature was 96.8°F. and pulse 140. A few hours later temperature rose to 100°F. and pulse fell to 100. The following day the right arm was tense, markedly swollen, and crepitations were felt just above the elbow. (Patient had been given several hypodermic injections in this arm.) Temperature was 104°F. and pulse was 106;

he appeared very toxic. He was taken to the operating room where long incisions to the bone were made anteriorly and posteriorly. The wound was irrigated with potassium permanganate; Dakin's tubes were placed in the wounds and permanganate irrigations q.2h. were given. Patient did not seem to rally following operation. Temperature was sustained at 104°F. for a time and then rapidly dropped to 98.8°F. Pulse dropped from 100 to 70. Patient died about thirty hours after operation.

CASE III. Thomas M. aged ten years, while on street was struck by motor truck and injured about right knee. On admission to the hospital he was in shock, complaining of pain about right knee region. The upper end of the tibia and calf muscles were exposed through the lacerated wound. At this time his temperature was 99.6°F. and pulse 110. Fifteen hundred U. of T.A.T. were given. He was treated for shock. One and one-half hours after admission debridement was done and Dakin's tubes were placed in wound. The next morning temperature was 102°F. and pulse 122. The next day he was given a transfusion (340 c.c. of whole blood). Following this multiple incisions were made above and below the knee and Dakin's tubes inserted; wounds were irrigated with Dakin's at two hour intervals. On the third day, patient was toxic, temperature was 104°F., pulse 136, signs of gas bacillus infection were found and immediate amputation through lower third of thigh was performed. Wound was left wide open. Following operation temperature and pulse gradually came down, infection of wound gradually cleared up and patient was discharged in good general condition on April 15, 1927, forty-nine days after admission.

Case IV. Rebecca S., aged fifty years, was admitted Jan. 7, 1926 for chronic cardiovalvular disease with acute cardiac dilatation. The next day there was some ecchymosis about site of hypodermic injection; this region was quite tender; subcutaneous crepitations were present. Temperature was 100°F. and pulse 122. Arrangements for transfusion were made and on Jan. 9, 1926 patient was given 450 c.c. of whole blood. At this time the process extended from finger tips to left side of neck, left axilla and chest; the entire left upper extremity was markedly swollen, black, pulse-

less and crepitant. Affected region had very foul odor. Following transfusion extensive incisions were made over arm, forearm, chest and axilla. There was a free escape of gas. Muscles were black and there was marked foul odor. All groups of muscles were separated and opened as wide as possible. Excision of tissues was not done because of poor condition of patient. Evidence of an old hemorrhage was found in the axilla. The vessels of the region were thrombosed. Temperature dropped to normal; pulse rate was 100. The patient became gradually weaker and died the same day.

Case v. Harry W., aged twenty-three, a laborer, on June 15, 1923 fell from a ladder while at work, sustaining injuries to both his legs. On admission to the hospital it was found that he had a simple fracture of lower right leg and a 4 in. laceration over the medial side of left ankle through which the tibia protruded. Both left malleoli were also fractured. At operation that night laceration previously described was found to communicate with the ankle joint. Fractures were reduced and cast applied. The next day temperature and pulse rate were increased, temperature rising to 103°F. On June 19, 1923 some necrotic tissue was seen about the wound and there was a foul odor present. On June 20, 1923 a diagnosis of gas bacillus infection was made and disarticulation through knee joint was done. Temperature and pulse dropped. Temperature was irregular, rising to 101°F. and to 102°F. General condition gradually improved but wound was sluggish and healing very slow. Aug. 16, 1923 low thigh amputation was done, following this procedure patient rapidly improved and was discharged Sept. 19, 1923 after ninety-six days in the hospital. Anaerobic cultures from wound revealed presence of Bacillus communis coli.

Case VI. Nestor K., aged nineteen years, a machine operator, injured while at work, admitted to hospital Aug. 28, 1923 for compound fracture of left forearm. This patient's arm was caught in a machine and his body whirled in the air. Two days later temperature rose to 103°F., pulse to 124. There was ischemia of forearm, fingers were purple and cold. The limb as far as midarm was swollen and brownish in color. Crepitations could be felt as high as the axilla. Pulse at wrist was obliterated. There was a

thin, yellowish, foul discharge. This same day the left arm was amputated. Anaerobic culture showed presence of gas bubbles. X-ray revealed rarified areas about fractures. These areas were interpreted as being due to the accumulation of gas. Following operation temperature and pulse dropped; toxemia subsided and patient improved rapidly. Subsequently the granulating stump was pinch grafted. Patient was discharged Oct. 13, 1923 after forty-six days in the hospital.

Case vii. Fannie U., aged fifty-five years, a housewife, admitted to the medical ward June 28, 1929 for diabetes mellitus and chronic purulent otitis media. After two days she was much improved. Temperature was about 101°F. and pulse 120. On July 2, 1929 temperature rose to 103°F. and pulse was 140. There was edema and tenderness about the ankle, also some swelling of left calf region and some tenderness along the tibia. It was thought at this time that patient was developing septic process about left ankle. White blood corpuscles 15,600 and P.M.N.'s 85 per cent. Blood cultures were taken. The following day the temperature and pulse dropped and patient felt better. On July 4, 1929 patient appeared extremely ill, temperature 98.6°F., pulse 100, blood pressure 70/45. Surgical consultation was requested. The left lower extremity was cold, had a sickening sweet odor, had a pale purple hue, was markedly swollen and there were crepitations present throughout the entire limb and even beyond Poupart's ligament. Patient was moribund at the time of this examination. She died the same day without operative intervention.

Of unusual interest were our 2 cases resulting from hypodermic injections. In a personal communication, Dr. Kenneth Taylor advised me that he had heard of several cases of gas gangrene following adrenalin. He believes that the cause of infection is probably due to local ischemia plus contamination. We believe that the usual precautions were observed and that the fluids were sterile. Both of these patients were brought in in severe cardiac decompensation. Since seeing I. M. Gage's article, we have felt that the source of these infections may have been the woolen blankets used.

These cases and the many others reported in the literature serve to confirm the opinion that gas gangrene is a virulent local and systemic infection which requires early diagnosis and prompt treatment if we are to reduce our morbidity and mortality rates. Extensive gangrenous areas requiring amputation may ensue in very few hours after infection takes place. Occasionally patients become extremely toxic and die in a short time.

For a clearer concept of this condition one should be familiar with the mechanism by which the disease is produced and also with the pathology that results. Previously the bacteriology was briefly considered. Gas gangrene is caused primarily by a group of anaerobic organisms. These bacteria grow best in muscle tissue. We would therefore expect this disease to develop in such wounds as have a diminished oxygen supply and injury or exposure of muscle. Gas bacillus infection most frequently takes place in deep wounds where the depth excludes oxygen. Lacerated and crushing wounds, hematomata and compound fractures, offer particularly favorable sites for the development of gas gangrene. Diminished blood supply to a part favors the growth of the anaerobes and the development of this gangrene. Bowlby points out that he had not seen gas gangrene in wounds about the face, head or neck and he attributes this to the copious blood supply of these parts. Gas bacillus infection is seen most frequently in wounds about the extremities. This has been explained on the basis of the more frequent contamination with dirt of these parts and also by the poorer collateral circulation in the limbs. We feel that the circumferential swelling acts as a tourniquet to produce a further ischemia which aids the process.

Once the organisms have been implanted the process extends longitudinally easily but extension across muscle from one to another is far more difficult. The bacteria grow rapidly at the site of infection. Gas and toxins are elaborated; autolysis of muscle takes place. The organisms spread between the muscle fiber and its sheath. A clear fluid is produced which separates fiber from sheath. Necrosis of the muscle follows and then the organisms invade the fibers themselves. The edema, gas and toxin act on the vessels and in turn cause a further ischemia of the part. The tissues are devitalized and soon there are extensive gangrenous areas undergoing putrefaction. The affected muscle appears dull, opaque and of brick-red color, resembling cooked meet. Even at this stage it is dead for it does not contract on stimulation nor does it bleed when incised. Later it becomes softer and gelatinous; its color changes to green, brown or black. With the local process under way, gas gangrene rapidly produces a severe systemic reaction. The pulse rate is quickened and the temperature rises. Acidosis is present. The patient appears gravely ill; the expression is anxious and signs of some degree of shock soon appear. Unless prompt treatment is instituted radical amputation becomes necessary to save life and in the more desperate cases death may soon follow.

The importance of early recognition cannot be emphasized too strongly. Ordinarily the patient is admitted with injury sufficient to cause tissue destruction. The usual routine treatment is begun and T.A.T. given. After a time, varying from six hours to several days and in some instances many days, the surgeon observes that his patient's progress is not satisfactory. There is increase of temperature and pulse rate. Severe pain, out of proportion to the trauma, is complained of in the wound area. Examination of the local condition will reveal swollen, tender, ecchymotic or brownish area around the wound. Usually there is thin, foul, pinkish discharge. Pressure about wound edges may effect escape of gas bubbles. Palpation may or may not disclose crepitations in region about the wound. In later cases the part is markedly swollen and discolored, red, purple, bronze or brownish; there is a characteristic decayed meat (sickening sweet) odor; the muscle tissue may appear brick-red or even black; and crepitations

can be felt unless the edema is so great as to hide them. Acidosis is present and so is shock, to some extent. Smears and cultures from the wounds frequently show the presence of the causative organisms. Cultures are really more useful to confirm rather than to make the diagnosis. X-ray reveals the gas bubbles scattered along the long axis of the extremity.

The early diagnosis of gas gangrene is usually not difficult provided its possibility of occurrence is constantly kept in mind. Dr. Armitage Whitman has pointed out to me that euphoria is frequently a symptom in gas gangrene. He has seen patients with temperatures of 104°F. or even higher who said that they never felt better in their lives. This feeling of euphoria persists almost up to death. It should be thought of and watched for in all cases of severe lacerated wounds, particularly of the extremities, crushing or gunshot wounds, compound fractures, etc. More than the usual pain in a wound, increased pulse rate and temperature, toxemia and shock should always make one suspicious. Smears, cultures and x-ray are helpful in those cases that develop slowly. The object is to diagnose the disease before the local signs are advanced. Marked swelling, discoloration, putrid odor, crepitations and escape of gas are late signs. Early diagnosis means early treatment and the results are always more satisfactory in those cases where the proper treatment has been instituted promptly.

Hendrig reports 4 cases of latent gas gangrene infection in wounded soldiers. These cases occurred about the sites of old injuries, some dating as far back as ten years, before the disease developed. These cases gave a long history of vague cramp-like pains without localization, periodic swellings, repeated breaking down of scars and prolonged ulceration without discharge. At no time did x-ray reveal air bubbles in the tissues.

Gas bacillus infection should always be considered as a serious illness; it is quite frequently fatal. The prognosis depends to some extent on the character of the infecting organisms. Prognosis is always poorer in those cases where streptococci are found in symbiosis with the anaerobes. The more superficial type offers a better prognosis than the deep type. The large, rapidly extending, fulminating type very frequently requires radical amputation; this variety naturally has the poorest prognosis.

TREATMENT

If we are to minimize the incidence of gas bacillus infection, we must always consider its development a possibility and do all in our power to prevent its occurrence. The causative organisms and the conditions most suitable for the development of gas bacillus infection are common knowledge and have been discussed previously. The condition may occur following slight wounds; in some cases only slight abrasions can be found; in some cases no break in the continuity of the skin can be demonstrated and in some cases it has followed hypodermic injections. One of us saw a case of gas bacillus infection in a case where the patient froze both feet. He refused amputation and gas gangrene developed. Thus we see that field or street contamination is not essential; nor must there be great soft part tissue destruction. Too great stress cannot be laid on prompt and thorough care of wounds. Skin cleansing and sterilization are very important, for Bacillus capsulatus aerogenes has been found on the skin, clothing and blankets of patients. In our series there were 2 cases resulting from hypodermic injections. Other writers have emphasized the fact that alcohol alone is not a safe skin sterilizing agent.

No set rules can be laid down for the treatment of wounds. The surgeon will plan his course according to the type of injury, the tissues involved, and the contamination. When the injury is of the crushing variety most writers agree that it is wise to excise the devitalized tissue in order to minimize the chance of infection especially by anaerobic bacteria. Daily inspection of the wound area is of the utmost importance.

As soon as suspicion of gas bacillus infection is aroused prompt incision (multiple long incision through skin, fascia and muscle sheaths to promote drainage and aeration and prevent ischemia) of the area should be performed. In the later cases when destruction of muscle is in evidence most writers advise excision of the devitalized muscle or even group of muscles. In the rapidly spreading, fulminating type, prompt amputation is indicated.

The reports on serum therapy appear contradictory and the efficacy of the sera (antitoxin perfringens and polyvalent anaerobic antitoxin) is still unsettled. Most writers believe that the sera are of some value in conjunction with surgical measures. All agree that serum, if used, should be given early in the disease and in sufficient dosage. Only 1 of our cases was given serum (antitoxin perfringens). This patient was a woman of sixty-five years (see case reports) with a severe infection which proved fatal.

Various chemical agents have been advocated for use in conjunction with surgery in the treatment of gas gangrene. The most important of these are hydrogen peroxide, potassium permanganate, Dakin's solution and Pilcher's mixture. Hydrogen peroxide and potassium permanganate were recommended in the belief that their power of oxidation would help check the infection. They have been used extensively without much beneficial effect. Dakin's is quite useful in ridding wounds of slough and aids materially in cleaning them up but it is not a specific formula for the anaerobes. Pilcher's mixture has been used because of the bactericidal action of quinine sulphate, which it contains. Pilcher and others report good results with this mixture. It is used like Dakin's solution. The mixture is not proteolytic and Pilcher has advised that after the anaerobic infection has been overcome, Dakin's solution be substituted for it.

No special mention is made here with regard to general supportive and systemic treatment as we feel that these and any other symptomatic therapy that may be indicated will be included in the management of the case.

In a recent article by Kling, normal horse serum is advocated for gas bacillus infection. While we have had no experience with this method and we do not wish to doubt its efficacy, we feel that the rationale of the method is not entirely clear. The advantages of adding normal horse serum to specific antitoxin appear problematical because the specific serum is, after all, horse serum and it seems more logical if larger doses are given that they be specific antitoxic serum.

In a disease of this sort so many factors enter into question of recovery that it becomes a matter for extremely critical judgment as to the value of serum therapy.

CONCLUSIONS

- 1. Gas bacillus infection should be constantly borne in mind as a possibility in all lacerated and crushing wounds.
- 2. We should be careful in our original care of these wounds, i.e., more careful with skin sterilization—excision of devitalized tissues—in order to reduce the incidence of gas bacillus infection.
- 3. Hypodermic injections should be given with greater care with respect to skin sterilization and the fluids should, wherever feasible, be introduced subcutaneously and not intramuscularly.
- 4. Gas bacillus infection should always be regarded as a serious condition.
- 5. Early diagnosis and prompt treatment insure better results.
- 6. In the diffuse, rapidly spreading, fulminating type affecting an extremity, early amputation becomes the treatment of choice.
- 7. Gas bacillus infection in those affected with myocarditis, diabetes mellitus and other debilitating conditions, is usually fatal.
- 8. The actual value of the available sera is still disputed. If given, it should be used early and in sufficient dosage.

[For References see p. 513.]

PERINEPHRITIC ABSCESS

A ROENTGENOLOGICAL AND CLINICAL STUDY* Leo G. Rigler, M.D. AND M. H. MANSON, M.D.

MINNEAPOLIS, MINN.

CLINICAL OBSERVATIONS

ROM a clinical point of view, the terms perinephritis and paranephritic abscess may be considered as identical. The simplest method of classification of perinephritic abscess is to divide the cases into two groups, those of renal and those of extra-renal origin. The preponderance of one type over the other is difficult of determination because the reports of cases in the literature are not entirely clear as to the source of the infection. A considerable difference of opinion exists as to whether or not a perinephritic infection, arising from a cortical abscess in the kidney, but hematogenously borne, shall be considered renal or extra-renal in origin. This may result in a considerable variation in the percentages of each type of case reported by various authors.

In 1909, Miller¹ found evidence of primary renal disease in 11 per cent of his cases while Braasch² in 1915 reported 56.4 per cent of his series as being renal in origin and Richardson³ gives 30 per cent as the number in his report. Brunn and Rhodes4 have recently written a clear and valuable essay on the mode of origin of the metastatic type of abscess which concurs well with our experience. It is these cases of extrarenal origin which are of chief interest from the diagnostic standpoint because of the difficulties which their

recognition presents.

The mortality rate in perinephritic abscess is surprisingly high. The statistics, however, would probably be very different if the cases were properly classified as to the origin of the abscess. Hunt⁵ in 1924 gave the mortality rate from various clinics as follows: Küster, 34 per cent; Miller, 14.3 per cent; Mayo Clinic, 6.6 per cent. These

figures include both types of cases. Of the 106 cases reported by Hunt⁵ from the Mayo Clinic no renal lesion could be demonstrated in 55.7 per cent. Where the distinction between cases of renal and extra-renal origin is made, a marked difference in mortality is noted. Scheele,6 for example, reports no deaths in 20 cases of the metastatic variety while Miller¹ states that the mortality rate is about 40 per cent for abscesses of renal origin and 20 per cent in those of extra-renal origin. The latter figure is markedly higher than in our series and is well above the average.

The most obvious cause of a high mortality rate is late diagnosis. Mr. S. A. Lane⁷ of Dublin puts the situation most cogently when he says, "Perinephritic suppuration in a previously healthy individual is not common enough for any one surgeon to have a preponderating experience in its diagnosis and it is doubtful whether any other abscess, or pus from any other situation in such phenomenal amounts, can elude detection for so long without seriously jeopardizing life." In 8 cases, which he reported, 7 were diagnosed so late that the lives of the patients were endangered. The mistaken diagnoses were variable including neurasthenia, rheumatism, sciatica, and hip joint disease, the last-named being the most favored. Two of his patients had their extremities put in traction and extension. Dunn,8 Bransford Lewis,9 and Braasch² have also commented upon the difficulty in diagnosis. The last one states, "I know of no condition in the field of urology which can be more difficult to diagnose."

The long duration between the onset of symptoms and hospitalization is well illustrated by the cases of Peacock¹⁰ in

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which, so far as could be determined, it averaged 38.8 days. In 44 cases from the Mayo Clinic, reported by Habein, 11 practically the same time had elapsed before surgical treatment. Eisenstaedt 12 from Breslau found the interval between the etiologic insult and the correct diagnosis to average about twenty-five days. In our series, if 2 cases of doubtful origin are omitted, the average time from onset of symptoms to hospitalization was about 22.5 days.

Using ordinary clinical criteria the early diagnosis is not easy for there is no characteristic symptom-complex. According to Habein¹¹ the clinical course may be divided into two stages, that of symptoms only and that of symptoms with localizing physical signs. In order to decrease the long interval between onset and surgical treatment, the diagnosis must be made in the stage in which symptoms alone are present.

Chills, fever, malaise, loss of weight, and backache are constitutional symptoms present in the course of perinephritic abscess but also present in a score of other illnesses. A careful history inquiring especially into facts relating to cutaneous infection, acute respiratory infection, and trauma should be sought. No doubt, one of the most important items in early diagnosis is keeping the condition in mind.

Physical examination may be of little value. However, tenderness in the lumbar region, more frequently on the right side, spasm of the erector spinae group of muscles, and a fullness or bulging posteriorly between the twelfth rib and the crest of the ilium, when present, strengthen the impression. The bulging in the lumbar region may not be visible. Actual measurement of each side from the umbilicus to the spinous process of the vertebrae may demonstrate this fullness when it is not otherwise apparent. The leucocyte count is usually from 15,000 to 20,000.

We have collected 19 cases of proved perinephritic abscess, in 11 of which adequate roentgen examination was made. Table 1

summarizes the findings in these cases and needs little comment as to the clinical data. It is of interest to note the variety of diagnoses with which the patients were sent in to the hospital, emphasizing again the necessity of keeping this condition in mind. Only 2 cases were definitely diagnosed as perinephritic abscess and in only 7 cases was a renal or pararenal lesion being considered before admission.

Classification of the cases into renal or extra-renal types was determined largely upon a history or demonstration of active foci of infection, and a negative urinary history. The following cases may be cited as examples: boils (xiv), finger infection (xvi), marked oral sepsis (i), influenza and pleurisy (x), frequent tonsilitis and hypertrophied tonsils (xII and XIII). The history cannot be relied upon accurately for Case XVIII gave a history of frequent boils, "influenza" and pleurisy. That the perinephritic abscess was the result of a large cortical abscess was shown by operation. Thus the renal infection was probably hematogenous in origin giving rise to a secondary perinephritic abscess.

The average age in our group was thirtytwo years; however, grouping the cases according to decades, we found the greatest number to occur in the twenty to thirty year period. All of the patients were operated upon, with one exception (Case vi), and there were no operative deaths.

In 2 cases nephrectomy was done. Case II had a functionless kidney as determined by cystoscopic examination; a perinephritic abscess was found at operation. Case XVIII was thought to have a renal tumor prior to operation, the diagnosis being based on a pyelographic defect which appeared quite characteristic of a neoplasm. This was seen to have been caused by a cortical abscess upon examination of the specimen.

The youngest patient (Case VIII) was two years of age. This case illustrates a common error in diagnosis and also the typical metastatic origin of many of the extra-renal type abscesses. The admitting

diagnosis was "hip disease, probably tuberculous." The first symptom noted was an apparent lameness followed shortly by

be of considerable value as has been recently pointed out in this country by Lipsett, ¹³ Beer, ¹⁴ Friedman, ¹⁵ and Brunn



Fig. 1. Right perinephritic abscess. Note shadows of psoas muscle and kidney on left and their absence on right. Cecum can be clearly visualized by its gaseous distention and it shows displacement toward spine.

inability to walk and a tendency to flexion of the right thigh. Prior to the onset of these symptoms the child had been ill with chicken pox. A definite diagnosis was established by needle aspiration followed by lumbar drainage.

The only death in this series is that of the elderly man (Case VI) who died of uremia and sepsis resulting from prostatic hypertrophy. Upon admission he had 600 c.c. of residual urine, the blood urea nitrogen was 48 mg. rising to 112 mg. three days prior to his death. Post-mortem examination showed multiple abscesses in the left kidney apparently originating in the calyces and extending into the cortex. There was a large collection of pus about the capsule of the kidney.

ROENTGENOLOGIC OBSERVATIONS

To increase diagnostic accuracy at an earlier stage, roentgen examination may

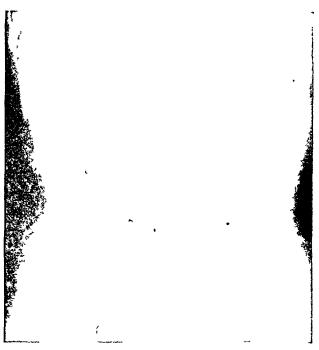


Fig. 2. Right perinephritic abscess. Note shadows of psoas muscle and kidney on left and their absence on right. There is a moderate scoliosis of lumbar spine with concavity toward affected side. Cecum can be clearly visualized by its gaseous distention and it shows displacement toward spine.

and Rhodes.⁴ In roentgenograms of the urinary tract both direct and indirect signs of perinephritic abscess may be obtained. Both types of findings were first described by Alexander¹⁶ in 1912, while a year later Koll¹⁷ reported 4 cases illustrating the direct signs only. Since then Laurell¹⁸ and Revesz¹⁹ have described all the findings in considerable detail. Fritz²⁰ and Pancoast and Fussell²¹ have especially called attention to upward displacement of the diaphragm on the affected side as an indirect roentgen sign.

The direct finding in the roentgenogram of an extra shadow, superimposed upon that of the kidney and representing a large, encapsulated abscess, is rare and of comparatively little importance. Calcification within the abscess has also been observed. We have had no experience with the direct signs so they will not be considered here.

The indirect signs are certainly more common and may be of crucial importance in the diagnosis of perinephritic abscess. The

Fig. 3. Right perinephritic abscess with upward displacement of diaphragm. Note high position of right diaphragm and blurred irregular density above it. Appearance is typical of subphrenic abscess. Same displacement can be demonstrated in other cases on left side.

most important of these is an obscuration of the psoas muscle shadow accompanied by a loss of the kidney outline. Both of these are considered together as they almost invariably accompany each other. It is obvious also that this sign is of value only when these structures can be clearly made out on the normal side. These findings are illustrated in Figures 1 and 2. The psoas muscle on the normal side is seen as a fairly dense triangular shadow alongside the spine with the base of the triangle below. On the affected side this shadow cannot be distinguished from the surrounding tissues. Likewise the kidney shadow on the abnormal side cannot be seen although it is fairly well made out on the opposite side. The exact cause for the loss of distinction of these two structures is not entirely clear, but it is probably due to infiltration and edema of their fatty capsules. Normally, because of their low density, these serve to produce the contrast which makes the kidney and psoas muscle shadows visible. Infiltration with a more opaque substance destroys this contrast.

We have attempted, in human and dog

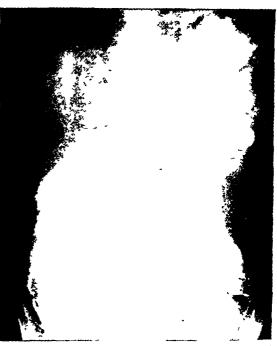


Fig. 4. Left perinephritic abscess. Barium enema reveals large pressure defect in descending colon which is also markedly displaced medially. (Courtesy of Dr. W. H. Ude.)

cadavers, to determine how small an amount of fluid injected into the perine-phritic tissues and into the capsule of the psoas muscle would cause obliteration of the psoas muscle and kidney shadows. These experiments were not entirely successful but tended to show that the loss of contrast in perinephritic abscess is not due to a simple collection of fluid but to the more complicated processes of edema and infiltration. This impression is borne out by the fact that comparatively small abscesses may produce an extensive obscuration of the shadows in the kidney region.

Scoliosis of the lumbar spine with the concavity toward the side of the lesion is another indirect sign which may be of some assistance. It may be very slight as shown in Figure 1 or more obvious as in Figure 2. Associated with this is an approximation of the costal margin and the crest of the ilium on the affected side.

The diaphragm on the affected side may be higher than normal and partially or completely immobilized. This is not at all

Fig. 5. Diagrammatic representation of most of roentgen findings in perinephritic abscess on right side. Note normal psoas muscle and kidney shadows on left and their absence on right. Right diaphragm is high and concavity of curved lumbar spine is to right. Right transverse processes of lumbar vertebrae are blurred. There is also an approximation of costal margin and crest of ilium on right.

a constant finding but when present is highly corroborative of the others. The appearance is much the same as that in subphrenic abscess as can be seen from Figure 3, a case of perinephritic abscess on the right side. The change in the diaphragm no doubt indicates that the infection has spread upward and produced a posterior subdiaphragmatic suppuration. In the case illustrated in Figure 3 the evidences of pleurisy above the affected diaphragm strengthen this impression.

The demonstration of displacement or deformity of the colon by the abscess, in our experience, is also corroborative evidence of considerable value. The colon may be visualized frequently by its gaseous distension as illustrated in Figures 1 and 2. Here the cecum is distinctly shown dis-



Fig. 6. Case xix. Perinephritic abscess with symptoms of only four days' duration and negative roentgen signs. Normal psoas muscle and kidney shadows on both sides are shown. Diaphragms and colon are normal in position. Slight scolosis of spine had been observed before onset of this condition.

placed toward the spine. If the abscess is chronic a barium enema may be given and the displacement or compression observed. This is very well illustrated in Figure 4, a roentgenogram of a case of left sided perinephritic abscess (case of Dr. W. H. Ude, Minneapolis General Hospital). The marked compression of the descending colon by the abscess is well shown. Obviously any mass in this region may give this same finding.

Other signs such as obscuration of the shadows of the transverse processes of the vertebrae and erosion of the vertebral bodies are rare and of little importance.

A composite picture of all the possible findings, with the exception of colonic displacement and compression is illustrated in Figure 5. This is a diagrammatic representation of the condition in a number of cases. The normal kidney and psoas muscle shadows are shown on the left. On the



Fig. 7. Polycystic kidneys. Left psoas muscle and kidney shadows are well shown but those on right are obliterated. There is marked scoliosis of spine with concavity toward right. (Courtesy of Dr. M. H. Nathanson.)

right they are quite invisible. The spine shows a concavity to the right while the transverse processes on this side are obscured. The right costal margin and crest of the ilium are approximated while the right diaphragm is much higher than normal.

In the group of cases of surgically proved perinephritic abscess shown in Table 1, 11 patients underwent some form of roentgen examination. In addition we have collected 6 cases in which some of these roentgen findings were present but in which the disease was of a different nature. These two groups of cases lend themselves to a critical survey of the value of the various indirect roentgen signs both as to their negative and positive reliability. The findings in the latter group are tabulated in Table 11.

Only 2 (Cases x and xix) of the 11 cases of perinephritic abscess showed a complete absence of any of the indirect signs here described. The duration of the disease from the onset until drainage was instituted was shorter in these 2 cases than in any of the others reported, one being ten days and the other only four days. The normal appearance of the latter is illustrated in Figure 6. This appears to be the most reasonable explanation for the absence of signs and would seem to indicate that the diagnosis cannot be made in the very earliest stages by the roentgen method. This idea is further borne out by the findings in Case XIII and Case XVII. In the latter, ten days after the onset, there were no positive findings except for a high diaphragm but three days later almost all the characteristic findings appeared. In Case xiii the findings had begun to appear at fifteen days but were insufficient for desinite diagnosis while at twenty-four days they were very characteristic. On the other hand in Case vii fairly definite roentgen findings were present eight days after the onset while in Case xvIII slight signs were present twelve days after, although the diagnosis was indefinite.

In all the remaining 9 cases in which a roentgen diagnosis could be made, obliteration, to a more or less degree, of the psoas muscle and kidney shadows was present. This was, therefore, the most constant and reliable sign. Scoliosis of the lumbar spine was present in only 4 of the cases and then to a very minimal degree. The diaphragms could not be properly observed in all of the cases examined because of improper technique. Of the 9 cases examined an upward displacement of the diaphragm could be seen in 5. In one of these (Case xvII) this sign was present before any of the others.

In all but 1 of the 11 cases, the colon on the side of the lesion could be clearly visualized, in the urinary tract films, by its gaseous content. Displacement to some degree, could be definitely made out in 6 of these 10 cases.

A small series of cases of different types, which might conceivably simulate perinephritic abscess clinically were selected for comparison. The findings in this group are shown in Table 11. Thus a case of acute appendicitis, with perforation and general peritonitis (Case xx), gave the roentgen evidence of obliteration of the psoas and kidney shadows on the right together with scoliosis of the lumbar spine. Thes hort duration of the illness (one day) indicated the improbability of the diagnosis but from a pure roentgen diagnostic standpoint, the differentiation would have been impossible. Case XXI illustrates the effect of a large abdominal tumor which produced the appearance of all the signs. The massive shadow of the tumor itself was apparent so that no error in diagnosis resulted but this case illustrates the fact that a smaller tumor might simulate the roentgen signs of perinephritic abscess more closely. A case of pyonephrosis with marked destruction of the kidney (Case XXII) showed all the roentgen findings except the high diaphragm and was most difficult to differentiate both clinically and roentgenologically although the infection was confined within the kidney capsule.

Two cases of polycystic kidney (Cases (XXIII and XXIV) were also observed. In Case xxiv all the roentgen findings of perinephritic abscess (Fig. 7) except the high diaphragm were present. The clinical distinction was, however, quite obvious. The fact that polycystic kidneys may give a one-sided change in the roentgenogram simulating perinephritic abscess must be borne in mind.

The final case (Case xxv) illustrates a change in the psoas muscle shadow (Fig. 8) which must not be confused with that occurring in perinephritic abscess. This was a case of psoas abscess and shows a marked enlargement of the left psoas muscle shadow with lateral extension and some change in form. No obscuration of the shadow is present although scoliosis of the lumbar spine is also shown.

A critical summary of these cases would

seem to indicate that the roentgen signs, while distinctly helpful, are neither pathognomonic nor highly reliable. In the very



Fig. 8. Left psons abscess. Left kidney shadow is obliterated but psoas muscle shadow can be seen greatly enlarged and bulging into flank. There is a slight scoliosis of spine with concavity toward affected side.

early stages, in our experience, the roentgen signs may be entirely absent or too slight for diagnosis. After the tenth day following the onset, x-ray findings may appear but may not be definite until a few days later. The absence of roentgen signs in the early stages, at least, does not rule out perinephritic abscess. After two weeks, however, the absence of roentgen signs may be considered of considerable significance. This close correlation with the value of roentgen diagnosis in acute osteomyelitis is notable.

Of the abnormal changes in the roentgenograms which have been considered. the obliteration of the psoas muscle and kidney shadows on the side of the lesion is by far the most important. Nevertheless this finding may occur in a number of other conditions such as acute appendicitis with perforation, polycystic kidney, abdominal tumor, pyonephrosis of marked degree.

An upward displacement of the dia-

TABLE 1
OUTHAL OF CHAICAL AND ROLNIGLY FINDINGS IN CASES OF PERINEPHRITIC ABSCESS

Pre-op-Referred Lettive Dugmosis. 1 cinp Dugmosis. 102° None 104° Renal meoplasm 106 to None 105° Renal meoplasm 106 to Renaphrite ub- 2 cers 2 cers 108° Retrocted ap-	de d		Roentgen Upwerd Displice- phragm			Outcome Prompt recovery Recovery Recovery Had bladder and read bladder and recovery Covery Covery Deed of urema absers found post-morten
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<u>.</u>	plasm re ub- l ap- min of				Lumbar drannage Nephrectomy Lumbar drannage Lumbar drannage Appendectomy G-5-22 Lumbar drannage G-15-22 Lumbar drannage	
<u>.</u>	t te ub- l ap- nyper- mna				Nephrectomy Lumbar dramage Lumbar dramage Appendectomy C-5-22 Lumbar dramage G-15-22 Lumbar dramage	
٠,	nte the		,		Lumbar dranage Lumbar dranage Lumbar dranage Appende comy 6-5-22 Lumbar dranage 6-15-22	<u> </u>
	re ub-				Lumbar drainage. Approductomy C-5-22 Lumbar drainage. 6-15-22	<u> - - - </u>
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pendicitis	of		1		Lumbar drannage	Dred of absects post-mor Prompt re
Prostate hyper- trophy aremin	ر. و و				Lumbar drainage	
100° "Pleurisy"	., 		1		-	
10 to "Hip disc ise."	Jo	_			Lumbar dramage	Prompt recovery
100° "Infection		9 Present	+ 1	Absent Absent	Lumbar dramage	Prompt recovery
100 5° None	10 days	Absent	Absent A	Absent Absent	Lumbar drainage	Prompt recovery
102° Retro-peritoneal	critoncal 20 days	Present	Slight A	Absent Present	t Lumbar dramage	Prompt recovery
102º Disphragmatic	Hematic 21 days	9 Present	Absent A	Absent	Lumbar drum ige	Prompt recovery
101° Appendicitis	icitis 15 days	s Singht	Slight A	Absent Absent	I umbar dramage	Prampt recovery
100° "Hp distare"	scase" 24 days	Present	Present P	Present Absent	Lumbar drain 18C	Prompt recovery
1020 Dislocated kidney	ated kidney 21 days	Present	Present P	Present Present	t Lumbar drainage	Prompt recovery
to3° Appendients	icitis 21 duys	Present		Present Present	t Tumbur drainage	Prompt recovery
104° Sprained back	d back To days	4 Absent	Present	Absent Absent	Lumb er dramage	Recovery
100 8º Abdominal	nni nb- 12 days	9 Present	Present P	Present Absent	Nebrectomy	Pyclancobritis
102° Perincphritic ab-	hritic ab- 1 days		Absent 7	Absent Absent	I umbar dramage	Recovery Prompt recovery

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phragm is also of considerable importance as it occurs rather frequently with perinephritic abscess. It will, of course, also

TABLE II OUTLINE OF THE ROENTGEN FINDINGS IN CASES OF VARIOUS TYPES OTHER THAN PERINEPHRITIC ABSCESS INDICATING THAT THESE FINDINGS MAY OCCUR IN OTHER CONDITIONS

İ	1	Roentgen Findings				
Case Num- ber	Obliteration of Psois and Kidney Shadows	Diagnosis				
20	Present	-		Present	Appendiceal abscess General perito- nitis	
21	Present	Present	Present	Present	Adenocarcino- ma of ovary	
22	Present		Present	Slight	Pyonephrosis	
23	Present	Absent	Absent	Absent	Polycystic kid- neys	
54	Present		Present	Present	Polycystic kid- neys	
25	Psons en- larged	Absent	Present	Present	Psons abscess	

occur with subphrenic abscess of any type, in certain intra-abdominal tumors, and in a variety of other conditions. The first two may simulate perinephritic abscess clinically.

Displacement and compression of the colon is a valuable sign as it may be present if the abscess is fairly large. It may, however, be present with any enlargement in the kidney region.

Finally scoliosis of the spine is of little value as a roentgen sign. It was present in less than half of the cases even in the later stages. It is a common finding in normal individuals and may occur with any acute abdominal condition causing pain, with any marked enlargement of any of the abdominal organs, and with abdominal tumors.

SUMMARY AND CONCLUSIONS

Nineteen cases of perinephritic abscess proved by operation or post-mortem examination are reported. Of these 16 were extra-renal, and 2 renal in origin while 1 was doubtful. Eleven cases were examined with the roentgen ray.

These cases illustrate the common errors in diagnosis and the usual long delay in the treatment of this condition because of the failure to diagnose it correctly.

Roentgen examination may be helpful in arriving at an earlier diagnosis of perinephritic abscess.

The most important roentgen sign is a loss of the normal psoas muscle and kidney shadow. Upward displacement of the diaphragm and evidence of displacement of the colon are next in importance. Scoliosis of the spine is of least importance.

The x-ray signs are frequently absent or doubtful up to ten days after the onset of symptoms. They are almost always present within fourteen days.

Six cases are reported including appendiceal abscess, abdominal tumor, pyonephrosis, polycystic kidney, and psoas abscess, in which the roentgen signs of perinephritic abscess were closely simulated. The x-ray findings are therefore valuable only as suggestive or corroborative evidence of the condition. Absence of the roentgen findings after a period of fourteen days from the onset should throw grave doubt upon the diagnosis of perinephritic abscess.

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CONDYLOMATA ACUMINATA COMPLICATING PREGNANCY

IN A WOMAN HAVING HAD FOUR PREVIOUS CERVICAL CESAREAN SECTIONS* Louis E. Phaneuf, m.d., f.a.c.s.

BOSTON

REPORT OF CASE

Tistory: Mrs. C. C. aged twenty-nine, was admitted to the Gynecological and Obstetrical Service of the Carney Hospital on October 31, 1930. She stated that she was pregnant for the fifth time. Her last period had started on February 20, 1930, making her confinement expected for November 27, 1930. Seven months previous to her admission she had noticed several discrete small warts about her external genitals; soon they began to coalesce into large masses and were accompanied by a thick, yellowish, irritating and very fetid discharge from the vagina. The discharge had existed for several months but she had paid no attention to it until the warty growths became troublesome. She was examined at another clinic. smears were taken and a Wassermann test was done. She was told to report for treatment but failed to do so. Sometime later she went to still another clinic where a diagnosis of gonorrhea and secondary syphilis was made. She was instructed to report for treatment but again this advice was not heeded. When her pregnancy had reached the beginning of the ninth month she appeared at my office and was referred to the Carney Hospital. She had had measles and pertussis in childhood, she had had her tonsils and adenoids removed at eleven years of age; otherwise she had always been well. Her family history revealed nothing of importance. She began to menstruate at the age of sixteen, her periods were regular, of the thirty-day type, lasting five days, she used four or five napkins a day, passed no clots and never had any pain. There was no bleeding between periods. The last period had occured on February 20, 1930. She had been married ten years and had four children, all delivered by myself, by the cervical cesarean section as follows.

PREVIOUS CERVICAL CESAREAN SECTION

1. March 20, 1922. Lest occipito-anterior

presentation. Justo minor pelvis. Large male child, cephalopelvic disproportion, twenty-four hour labor, floating head, one vaginal examination outside before admission. Veit-Fromme-Hirst transperitoneal cesarean section. The mother made a good recovery but the baby died at the end of five days.

2. August 20, 1923. She was delivered of a female child by a cervical cesarean section of the Kroenig type. The previous cervical scar was found perfectly healed. Both mother and baby were discharged well. This baby died of convulsions at the age of two years.

3. February 5, 1925. She was delivered of a male child by a cervical cesarean section of the Kroenig type. The two previous cervical scars were found to be well healed. Both mother and baby were discharged well.

4. April 10, 1926. She was delivered of a large female child, weighing 9 lb. and 5 oz. (4246 gm.), and presenting by the breech by a cervical cesarean section of the Kroenig type. The lower segment was thin but firm and the three previous scars could not be identified. No pelvic adhesions whatsoever were found. Both mother and baby were discharged well.

Physical Examination: There was evidence of healing scabies on admission. The teeth were poor and there was evidence of pyorrhea alveolaris. The heart and lungs were normal as were the breasts. The abdomen showed a healed median pelvic incision, it was symmetrically enlarged, the fundus of the uterus was two fingers breadth below the ensiform cartilage, the fetus was presenting by the vertex in left position, the fetal heart was heard in the left lower quadrant and was of good quality. The blood pressure was systolic 105 and diastolic 70. The vulva revealed a conglomeration of papillary excrescenses; multiple, diffuse, over the labia and extending on to the perineum, into the vagina and upward toward and around the urethra (Fig. 1).

The blood Wassermann test was strongly positive, but the complement fixation test for gonorrhea was negative.

*Submitted for publication April 23, 1931.

Since it was thought that the sloughing condylomata and the offensive discharge might be responsible for sepsis following cesarean

Fig. 1. Condylomata acuminata, covering vulva in quinquipara having had 4 previous cervical cesarean sections.

section, it was decided to remove the infected masses surgically.

Operation: On November 3, 1930, spinal anesthesia was induced using 120 mg. of novocaine crystals dissolved in 3 c.c. of spinal fluid and reinjected. The vulva was prepared. The condylomata were dissected from the posterior vaginal wall, both labia majora, the anus and the anterior vaginal wall below the urinary meatus. The raw areas were approximated by interrupted sutures of No. 2 chromic catgut. A few small discrete condylomata were fulgurated with the actual cautery. A selfretaining catheter was introduced in the bladder, a pressure dressing was applied and the patient was returned to bed in good condition.

The histological examination of the removed masses led to the diagnosis of "Condylomata Acuminata."

The vulva healed readily, without complications. The patient was given an ampoule of gray oil by injection on November 21, 1930. On November 22, 0.900 mg. of neoarsphenamine was administered intravenously. This last treatment was repeated on November 25. The blood taken on this day showed a positive Wassermann test.

Fifth Cervical Cesarean Section: On November 26, 1930, the patient, having reached term, was prepared for operation. Under ether anesthesia the previous median suprapubic scar was resected, the peritoneal cavity being entered between the bellies of the recti muscles. Although this was the fifth cervical cesarean section, no adhesions whatsoever

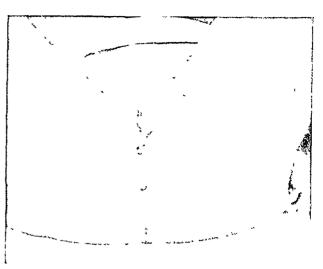


Fig. 2. Vulva before discharge of patient from hospital.

were found in the pelvis. The bladder was easily separated from the lower uterine segment for the fifth time. The lower segment was incised transversely with bandage scissors and a female child, who cried spontaneously, was delivered by the vertex. The placenta and membranes were expressed through the incision. The cervix was dilated from above. One cubic centimeter of pitocin and I c.c. of gynergen were injected in the thigh muscles. The uterus contracted well. The transverse cervical incision was closed in two layers, the first with interrupted sutures, the second with a continuous suture, burying the first layer, using No. 2 chromic catgut. The bladder was sutured back on the uterus with a running stitch of No. o chromic catgut in such a way that it completely covered the cervical incision and made it retrovesical. The omentum was brought down, placed behind the uterus, and the abdominal incision closed in layers.

Convalescence: The convalescence was satisfactory and unusually simple. The highest temperature was 101°F. (38.4°C.), on the fifth day, the pulse rose to 120 on the ninth day and the respirations reached 25 on the day of operation. The sutures were removed on the ninth day; the incision had healed by first intention. The patient was given a head rest on the tenth day and allowed out of bed on the twelfth.

The baby weighed 7 lb., $7\frac{1}{2}$ oz. (3366 gm.) at birth. She showed no gross syphilitic lesions. She was placed on a modified milk formula and did well. Both mother and baby were discharged on December 10, 1930, fourteen days after delivery. Both patients were referred for anti-syphilitic treatment.

At the time of discharge the abdominal incision was well healed, there was no induration and no tenderness. The vulva was healed (Fig. 2), the cervix was closed, the uterus was involuted, in forward position, movable and the adnexa and parametria were normal.

COMMENT

This case presented two important points of interest. First this woman apparently contracted gonorrhea and syphilis after her fourth cervical cesarean section. The presence of large masses of sloughing condylomata acuminata resulting in a fetid and infectious discharge made us fear that puerperal sepsis might

result after the fifth cervical cesarean section which had to be performed in a month. While some of these lesions are amenable to conservative or medical treatment, we felt that during the time at our disposal better results would be obtained by surgical excision of the sloughing masses. Subsequent events proved this contention to be right. Secondly, we had the opportunity to see the abdominal cavity and to examine the lower uterine segment after four cervical cesarean sections had been previously performed. It was gratifying to find no abdominal adhesions whatsoever and to find the segment well healed and solid. This result may serve again to emphasize the fact that a cervical scar is safer than a corporeal one in the performance of cesarean section.

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TUMORS OF THE FUNDUS OF THE UTERUS*

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IN a discussion of tumors of the uterus one is constantly impressed with the antithesis exhibited in tumor growth which occurs at the opposite extremities of the uterus.

The fundus is the site of the great classical myomatous tumors which represent the most conspicuous family of benign uterine growth, whereas the cervix is seldom the site of like tumors.

We find the cervix the most prevalent site of malignant growth in contradistinction to the comparatively infrequent occurrence of fundal malignancy.

We are further educated as to the contrasts of fundal and cervical newgrowths. We find fundal type of malignancy quite amenable to surgery, whereas cervical malignancy is less so. Again, malignancy of the cervix yields more often to irradiation than that of the fundus.

We also have exemplified in uterine growth the contrast between the active period of ovarian function in its relation to benign tumors as opposed to the frequency of malignant growth in the declining period of ovarian function.

Although function and injury play a part in bringing about the contrasts between fundal and cervical newgrowth, there is however sufficient distinction between tumor growths of the upper and lower poles of the uterus to be of definite value from the standpoint of etiology, pathology, diagnosis and therapeutic advice.

We are more concerned in this discussion of fundal tumors of the uterus with clinical history, diagnosis and treatment than we are with the histopathology of the subject.

The great size of the myomatous tumor

of the fundus of the uterus affords the most spectacular field in abdominal surgery, the greatest operative desire for the beginning surgeon and often his Waterloo. Further, these large benign fundal tumors afford the greatest surgical tragedies of any condition amenable to abdominal surgery.

GENESIS OF MYOMATOUS TUMOR

Although all myomas probably exist early in fetal life as seedlings, we are not made aware of the growth until the active function of the ovaries is made apparent. It is pleasing to have even this bit of information in regard to the genesis of newgrowth of any nature.

Ulesko-Stroganowa says he believes:

. . . that the genesis of uterine myomas can now be considered definitely established. Genetically they develop from the same cells on which depend both the physiologic growth of the myometrium and its physiologic hyperplasis during menstruation and during pregnancy. These cells comprise muscle tissue already present and embryonal (mesenchymal) rests, principally, and adventitial cells in the walls of the blood vessels. One of the chief stimulating bodies concerned in the development of uterine myomas is the ovarian hormone. In the absence of ovarian function (before puberty or in the climacteric) uterine myomas do not develop. The varied histologic pictures in uterine myomas are caused by the various degrees of differentiation of the young muscle cells and of the myoblasts. Malignant myomas develop as the result of an extremely rapid and unsurpassed multiplication of the young muscle cells and of the myoblasts that have lost the power of differentiation.

DIAGNOSIS OF BENIGN FUNDAL TUMORS

Too little attention is given to the diagnosis of fundal tumors. If the tumor

^{*} Presented at the meeting of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons in Niagara, September, 1930.

is not of sufficient size to be easily recognized as an abdominal mass, the patient most often presents herself to the hospital on account of possible uterine hemorrhage.

American Journal of Surgery

In dealing with uterine tumors hemorrhage is supposed to be the most frequent, alarming and most important diagnostic symptom in gynecology.

Although hemorrhage may easily be considered the most conspicuous symptom in uterine growth, I question whether it is the most constant symptom of benign growths of the uterus. Pain or discomfort is more often the sign of benign growth and is more often experienced in myomatous and adenomyomatous growth than in malignancy of the uterine fundus.

We have been taught that uterine newgrowth is without pain, it is my opinion such cannot be said of benign tumors of the fundus.

Dr. J. E. Davis of Detroit gives an excellent review of 335 hysterectomies performed in a city of 1,500,000 population by 35 operators in 6 different hospitals. This paper represents a cross section of the work done in a large city; the mortality was 4.68 per cent. The author gives as his message an appeal for more careful history taking and teaches as the triumvirate of symptoms of uterine tumors, pain, tumor and bleeding. Pain, 65 per cent of the cases; tumor of the abdomen, 40.8 per cent; hemorrhage, 31.3 per cent; sarcoma, 0.6 per cent; multiple growths, 86 per cent.

The percentages of the symptoms given in Dr. Davis' review are more in accord with my experience than is often given in popular teaching in our textbooks.

The symptoms of the benign tumors of the uterus are not so much due to the size of the growth as they are to location. Hemorrhage is much influenced as to location of the tumor in the uterine wall; the nearer the endometrium the greater the hemorrhage, whereas, the lower in the pole of the uterus the more the symptom of distress or pain is conspicuous. So the student of the subject by careful

investigation should be able to develop the cause or reason why certain tumors are painful and others hemorrhagic.

The tumors which are the most difficult to remove are, as a rule, the most painful which is due to their pelvic position, such as interligamentary or subvesical leading to pelvic congestion, whereas, the big fundal tumors which rise freely into the abdominal cavity are, as a rule, without pain and surgically easily managed.

There is a great deal of truth and value in the thought that any newgrowth is both more symptomatic and destructive if its location is crowded or confined by unyielding walls. We see this principle exemplified in malignancy of the fundus as compared with the upper two-thirds of the cervical canal, and although we are aware that metastasis is much more fertile in the cervical region than in the fundus of the uterus, I yet feel that the unyielding and narrow cervical canal has a good deal to do with the rapid penetrating growth seen in the cervix.

Myomatous growths of the uterus are very prevalent in women past thirty-five years. Dr. Ill, of Newark, reports from an excellent and reliable review that 27.9 per cent of the white women in America over thirty-five years of age have myomatous tumors. We can safely add 10 per cent to these figures for the colored women.

Joseph Price often made the statement in his clinic that the uterus was intended to be an industrious organ and if it did not bear children it would bring forth a fibroid. There may be a definite relation between sterility and the myomatous growth of the uterus, but whether or not the growth predisposes to sterility or sterility in itself is a factor in the growth, is a proposition which requires more definite study as to physiology, pathology and etiology in the particular case.

We have already referred to the fact that the most active era in ovarian function bears a close relation to myomatous tumor and yet the active age of the ovary is the fertile age of the patient, just an

example of another clash between physiology and pathology.

ASSOCIATION OF THE MYOMATOUS TUMOR WITH MALIGNANCY

In a large percentage of fundal malignancies we have found associated myomatous tumors. The two growths are not often intimately associated with each other as to point of location, each existing as a distinct growth, with the exception of sarcoma.

Myomatous tumors of the fundus which have undergone a metaplasia and are revealed as sarcomas are of course more intimately associated with the benign myomas.

This association of malignant and benign tumors of the uterine fundus should constantly be kept in mind as hemorrhage may be the only common symptom of the benign and malignant growth.

It is a grave mistake to assume that hemorrhage from the uterus which has been taking place for from five to ten years could not come from a malignant growth. I have seen this many times, the removal of the uterus not revealing any other cause for the hemorrhage other than malignancy.

The myomatous tumor in the uterus has nomadic habits. There seems to be a tendency for the intermural growth to become more subperitoneal, later pedunculated or entirely cast off into the abdominal cavity, becoming a parasitic growth and nourished by adhesions to the abdominal structures. This change of position of the myomatous tumor can be accounted for by the fact that its circulation comes from the inside of the uterus and therefore the stroma between the growth and the peritoneum is constantly being pressed upon and as its circulation is interfered with the growth becomes more subperitoneal. Also there is a tendency for the intermural fibroid to become submucous, then pedunculated or even entirely cast off into the uterine cavity. I have seen 6 submucous growths as large as a small walnut detached and lying loose in the uterine cavity. The condition is always accompanied by a very odorous discharge which is quite diagnostic.

One should constantly keep in mind the pedunculated submucous benign tumor in dealing with supposed malignancy of the cervix. The most pleasing experiences of my surgical work have come from a recognition of a pedunculated submucous growth of the fundus of the uterus which had been delivered through the cervical canal and was exhibited as a great bleeding mass quite obscuring the entire cervix and having been diagnosed as late malignancy with hope abandoned. These conditions when kept in mind can be easily recognized. The diagnosis is made by passing the finger around the bleeding mass and recognizing the pedicle passing into the uterine cavity.

Dr. Ewing feels we should be more apprehensive in the heterotopic or extrauterine positions of the myomatous growth on account of a greater liability of the tumor as a source of sarcoma. I have always felt that the myomatous growth located in the broad ligament was more prone to sarcoma and one should be mindful of rapid increase in size of a benign tumor in extrauterine location.

THE ADENOMYOMA, ENDOMETRIOMA OR ENDOMETRIOSIS

I have always looked upon this tumor as a hybrid as it seems to have as its progenitors both connective and epithelial tissue. Clinically we have not been in the habit of attempting to make a differential diagnosis between fibromyoma and the adenomyoma. A careful study of the benign growth removed from the fundus of the uterus with an idea of associating the particular growth with the clinical history of the case, will quite uniformly reveal symptoms which are typical of the adenomyoma.

The adenomyomatous uterus may not be much enlarged, seldom over twice that of the normal uterus, it is very often a symmetrical organ, the growth often principally involves the anterior and posterior walls producing marked thickening, may encircle the entire organ or appear as a local and definite growth.

Hemorrhage as a rule is profuse and pain is so often constant with the period that it may be looked upon as diagnostic of the adenomyoma.

The excessive amount of mucous membrane which is incident to and typical of the adenomyoma is the probable cause of the painful menstruation. The numerous glandular structures throughout the growth participate in the congestion incident to the menstrual period and thus the pelvic pain characteristic of the growth.

The uterus is the probable source of the adenomyoma. There has been much discussion in the literature by F. von Recklinhausen, Cullen and Sampson as to the source of this growth. They cite as probable sources the embryonic elements of the wolffian and müllerian fetal structures, Sampson taking the ground that the adenomyoma has its source in the mucous membrane of the uterus and that many of the extrauterine locations of the tumor may be accounted for by implants which have passed from the endometrium by way of the tubes and ingrafted the growth upon the pelvic and surrounding structures.

It is difficult to account for the source of the adenomyoma from any one of the theories which have come forth as popular teaching on account of the vagaries of the growth and its various locations.

Lockyer very well describes the condition when he says:

We must regard adenomyoma as a hemorrhagic and painful structure which is found in bad company, its intimate associates being adnexal tumors, pelvic peritonitis, parametritis and infiltrations into the bowel wall, whilst it can claim caseating tubercle, carcinoma and sarcoma as casual acquaintancies.

The thought has been advanced that adenomyomas may form as an intermediate stage in the transition from an inflammatory to a malignant process.

It is good teaching to advise that a pain-

ful benign tumor which is not accompanied by adnexal infection is probably an adenomyoma.

SEPTEMBER, 1931

The myomatous tumor of the uterus is often accompanied by the big white ovary. This I believe is often the source of pain which accompanies the myomatous growth.

Virchow referred to this type of ovary as due to an interstitial öophoritis with cystic degeneration, "which very well described its pathology.

Both the myoma and the adenomyoma are prone to cystic degeneration which may undergo further destruction and lead to a great cavity containing pus. This condition should be kept in mind when big tumors are being operated on.

Students so often ask just what is the true significance of uterine hemorrhage. The symptom is indicative of so many conditions both uterine and constitutional, that it is difficult to give a line of thought from which the student may reason. It has been our teaching for years that uterine hemorrhage is either due to pregnancy or not. If pregnancy is to be considered, we can, as a rule, by ordinary examinations plus clinical history of the case, dismiss the probability of placenta previa and abortion with retained membrane.

Tubal pregnancy is to be considered in uterine hemorrhage but the acuteness of the condition, paroxysms of sharp pain, moderate black discharge and a tender cervix, quite rule out possible uterine tumor.

Pregnancy in one horn of the uterus is to be considered in uterine hemorrhage. This condition can nearly always be palpated with considerable ease.

Uterine hemorrhage from either hydatidiform mole or chorioepithelioma comes up for serious consideration in dealing with possible fundal growths when hemorrhage is the most prominent symptom.

Uterine hemorrhage not due to pregnancy brings forth the thought of all newgrowths of the mucous membrane of the fundus of the uterus and cervix plus those newgrowths which involve the entire uterine stroma. Hyperplasia of the endometrium is certainly of a tumorous nature. Constitutional conditions which may cause uterine hemorrhage belong to medical therapeutics.

SIGNIFICANCE OF CERVICAL POLYPUS

From experience we have learned to look upon the cervical polypus as a sentinel of like growth of the uterine fundus. The polypus coming late in life and after menopause cannot be dealt with as a single innocent lesion.

We have found that over 60 per cent of the cases of cervical polypus have shown tumor growth of the fundus, so we do vaginal hysterectomy in nearly all cases of cervical polypus unless there is a marked contraindication to removal of uterus.

It is a common experience to have the patient who has had a cervical polypus removed, come to the hospital on account of continued uterine hemorrhage. Removal of such uterus nearly always reveals polypi of the fundus, a submucous myoma or the condition of polyposis of the fundus which may be a forerunner of malignancy.

MALIGNANT CONDITIONS OF THE UTERINE FUNDUS

Fundal malignancy although much less frequent than cervical carcinoma must constantly and uppermost be kept in mind in dealing with fundal newgrowth.

Dr. Welsh in reviewing 31,000 cases of malignancy reports the uterus was involved in one-third of the cases.

The frequency of fundal malignancy compared with that of the cervix is variously expressed by men of large experience and integrity and their reports vary from 5 per cent to 30 as compared with cervical malignancy.

American authors report a higher incidence of fundal malignancy than authorities on the continent.

From my experience I would say, 5 per cent was low and 30 high; however,

our experiences differ in certain eras of our work, and are also modified by methods of examinations.

Whereas carcinoma of the cervix is much more frequent than like growth of the fundus, sarcoma of the fundus is more frequent than like tumor of the cervix.

In my experience sarcoma of the fundus has been ten times as often seen as sarcoma of the cervix.

Sarcoma of the fundus of the uterus is most often found in intimate relation to a myomatous tumor and most often described as a malignant degeneration of a fibroid or myomatous growth.

Probably the term metaplasia would be a better description of the cellular change. The term degeneration should be used to describe a less active process or at least one used to describe a less active process or one where cellular growth is not stimulated. Malignancy is a stimulated growth of new tissue, whereas degeneration is a destructive process.

If the sarcoma of the fundus involves the endometrium it may appear as a discrete growth or exist as a diffuse condition of entire uterine fundus. The sarcoma which appears as a grape-like growth more often involves the cervix and at times in the very young. This cervical condition should be kept in mind.

Sarcomas in their intimate relation to myomas are rarely recognized until after removal of the tumor, so evidently the percentage of sarcomas as malignant fundal tumors is greater than is apparent, as many sarcomas are overlooked on account of their intimate association with the benign growth. This would register in favor of hysterectomy in treatment of fundal newgrowth.

It is impossible for the pathologist to examine all parts of the great fibromyomatous growths which so often involve the uterine fundus.

Pregnancy does not bear the important and definite relation to the sarcoma of the uterus that is found in carcinoma, for reasons which are apparent in cervical 476

injury, etc. However, the frequency of the benign fundal tumor so often seen in the nullipara may be a predisposing cause to the sarcoma which is so often associated with the benign tumor.

CHORIOEPITHELIOMA AND HYDATIDIFORM MOLE

Chorioepithelioma and hydatidiform mole occupy a most important place in the discussion of uterine hemorrhage and fundal tumors and if one does not have these conditions in mind a fatal lesion may be overlooked.

It is well to be mindful of the classification of hemorrhage from uterus as to whether or not it is due to pregnancy or any relation to a previous pregnancy, as we know that both chorioepithelioma and hydatidiform mole have their genesis in chorionic epithelium as the syncytium is a fetal structure.

To make a differential diagnosis between chorioepithelioma and hydatidiform mole is most difficult in many particulars. The clinical history may be most helpful. If the patient has had a normal labor and there is no evidence of benign tumor in uterine body and the placenta has been properly removed, then early and profuse hemorrhage following labor should make one consider chorioepithelioma; whereas, the distended uterus which is supposed to be pregnant, hemorrhage taking place and the organ of a more advanced size than the supposed term of pregnancy would allow, should make one think of hydatidiform mole.

The patient with hydatidiform mole often complains of a distending sensation of the uterus due probably to the rapid growth of the mole. If a grape-like mass which is characteristic of hydatidiform mole is protruding from the cervix, one has quite definite evidence of mole.

Diagnostic conflict must often come from an attempt to define the chorionic growth as to malignancy or benign tumor.

It is to be remembered that the trophoblast is normally invasive tissue even to a marked extent in normal pregnancy and also that trophoblastic pulmonary emboli occur in a large percentage of normal pregnancy.

Normal placenta remnants left in a uterus after full term pregnancy or miscarriage have not infrequently been taken for chorioepithelioma. Some pathologists do not consider the hydatidiform mole as a definite tumor but as a degenerative lesion.

Novak classifies the choriomatous tumors as choriomabenignum corresponding to the hydatidiform mole and choriomalignum as chorioepithelioma.

We are all the more confused in the proper interpretation of these chorionic growths when we are taught that they appear in ectopic locations, such as tumors of the testis and in patients in whom there is no history of pregnancy, for instance, in the very young virgin.

Even our most experienced pathologists claim that it is almost impossible to diagnose the chorionic tumors from uterine scrapings unless a portion of uterine stroma is removed with the specimen.

There is a marked contrast between the very acute and rapidly fatal outcome of some of the chorioepitheliomas and the more chronic and mild mannered forms of the growth.

The chorioepithelioma has been known to appear many years after pregnancy of either uterus or tube, the chorionic element remaining quiescent for so long and then appearing in a malignant form.

Statistics show that about one-third of all cases of chorioepithelioma follow a previous mole. It does not follow that one-third of all cases of hydatidiform mole are followed by chorioepithelioma; if so our duty would be to remove the uterus in all cases of hydatidiform mole.

Inasmuch as I have seen a number of very acute deaths from chorioepithelioma, I am each year more inclined to remove the uterus in the mole cases.

I have always been apprehensive for the patient in whom the uterus had been curetted for mole. To curet the chorioepithelioma is a fatal mistake.

The accompanying lutein cysts most often bilateral may aid in the diagnosis. The cysts are more frequent with mole than with chorioepithelioma and tend to disappear when the uterine growth is removed.

The metastatic growth from the more chronic forms of chorioepithelioma will often disappear after removal of the uterus.

This factor of influence which is shown by the disappearance of distal implants or metastatic growth when the parent growth is removed is seen in the removal of the great papillary cysts adenomas; it is also seen in the removal of the cysts of the ovary which may be companions of the adenomyoma of the uterus and of like pathologic growth again seen in the removal of the uterus for chorioepithelioma and often seen in the removal of an abdominal tuberculous mass, or removal of one tuberculous kidney followed by improvement of the other.

In all conditions of malignancy of the fundus of the uterus, the lungs should

be x-rayed for metastasis.

ADENOCARCINOMA OF THE FUNDUS

Adenocarcinoma is a type of fundal malignancy and it is not within the scope of this discussion to enter further into the histopathology of carcinoma of the fundus.

This type of tumor has various degrees of malignancy; its physical character as to exfoliating into the fundal cavity or penetrating rapidly into the stroma of the uterus may determine the prognosis, difficulty of diagnosis and treatment.

The condition is found, as a rule, ten years later than cervical malignancy;

metastasis takes place late.

The ratio of this condition is 1 to 20 as compared to cervical malignancy. Pregnancy seems to have little influence, whereas, the childbearing woman is prone to cervical malignancy. Myomas are very

often associated with fundal malignancy, not so often cervical.

The growth remains restricted to the fundus for a great length of time, even many years in a great percentage of cases. The prognosis is very good as compared with cervical malignancy.

TREATMENT OF FUNDAL TUMORS

We feel that treatment of fundal tumors is largely surgical and do not advise irradiation in either benign or malignant growth of the fundus. Regarding the great benign fibromyomatous growths of the fundus the treatment is hysterectomy.

Greater pains must be taken in obtaining a more accurate clinical history; heritage should be looked into. Undoubtedly there are instances of family predisposition to the benign growths of the uterus.

Mertini calls attention to heritage in cases of diffuse fibromyomatosis of the uterus in the very young with a history of severe dysmenorrhea.

A careful clinical history will often reveal a cardiorenal condition in the large be-

nign tumor of the fundus.

We have almost abandoned myomectomy, first on account of the multiple tumor growths and again in those cases where the uterus is preserved for child-bearing purpose the uterus has remained sterile. Other operators report more favorable results.

A greater percentage of sudden and unexpected deaths occurs following surgery of the fibroid tumor of the uterus than in any other abdominal operation. We have contended that there is a cardiac muscular change incident to the myomatous growth of the uterus.

We are unable to say that the benign fundal tumor produces a toxemia due to the newgrowth or degeneration in the way of tissue change, but there is often present this cardiac failure. The abdominal wall seems to increase in thickness which is certainly not legitimate tissue growth. Evidently a good number of sudden deaths following hysterectomy of the big benign growths are not due to embolus. The patient with a large myomatous growth should be kept in bed a week or ten days before operation.

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A close observation will often show a mental aberration in the patient who has carried a good-sized myomatous tumor of the uterus for a number of years, such mental change coming on near the age of menopause. Dr. Price often called attention to this mental condition.

During the past years we have had some experience with the treatment of fibroid fundal tumors by irradiation which is very significant. A number of these cases had been advised hysterectomy for fibroid growth; operation being refused, irradiation was done, the patient returning for hospital attention with a general malignancy of the abdominal cavity.

Whether or not the uterine growths were adversely affected or possible coexisting ovarian cystic growths were stimulated to a rapid malignant change, is quite impossible to say as the malignancy was so general that it obscured the initial point of involvement.

Mornard has reported a number of cases of extremely rapid malignancy grafted upon fibroid of the uterus following treatment by irradiation.

Professor J. L. Faure, of Paris, calls attention to the aggravation of ovarian tumors by irradiation during the treatment of fibroid tumors of the uterus. He refers to the rapid increase of size and possible malignant change.

It would appear from a summation of the entire problem involved in the treatment of uterine newgrowth, that we have the following features to consider. What is the value of the uterus to the particular patient? What is the price of its removal tmortality, morbidity, etc.)? If less radical methods of treatment are endorsed and the uterus is to be saved, how accurate is the diagnosis as to the nature of the expected growth? What are the risks of the

methods of investigation, such as uterine curettement?

First must be kept in mind the tragedy of overlooking malignancy when the uterus is to be saved.

All conservative methods of treating uterine tumors must take into consideration the entire organ and not one of its extremities. We have no right to treat the cervix and always take for granted the well-being of the uterus higher up.

The mortality of removing the uterus is constantly being reduced by better organization and more masterful technique.

In a report of a series of 148 hysterectomies by Billroth in 1892, there were 65 deaths, so by comparison it can be seen what rapid progress has been made.

The mortality for hysterectomy over our country will range from 2 to 10 per cent and would be higher if the hysterectomy from above always included the cervix. So this may be the price of the hysterectomy as an abdominal operation.

We do vaginal hysterectomy by the clamp method in all cases where the size of the uterus permits. The mortality has been kept below 0.5 per cent in our series of cases.

Professor Zweifel says, "no one can say that radiation therapy has or ever will replace surgery by virtue of its superior results, this ideal goal will never be reached." One must always take into consideration the resistance to radiation which some types of malignancy exhibit, especially the glandular variety.

In our experience, 95 per cent of the patients in whom a hysterectomy is indicated are at an age when the uterus is of minor service, so there is little morbidity.

If we pit vaginal hysterectomy against the radical operation from above, will the more radical procedures when done for malignancy compensate for the very much higher primary operative mortality?

We have chosen the clamp method of performing a vaginal hysterectomy because it is a very much more radical procedure than when performed by the ligature method and has a greater range of operability.

Probably it is necessary for me to qualify this statement as to the clamp method of removing the uterus having a greater percentage of operability than the ligature method. Dr. Adler, of Vienna, is doing a very radical vaginal hysterectomy by ligature method followed by irradiation with excellent results. His primary mortality is much higher than ours by the clamp method which might he expected from the very radical operation he does.

We have always claimed the sloughing of the tissues which are within the bite of the clamp further removes malignant or potentially malignant tissue.

The curette is most often used as a method of diagnosing fundal growths.

I have not been able to endorse the teaching that curettement of the fundus of a malignant uterus is without harm.

The statement is quite constantly made that there is no evidence of malignancy being transplanted or metastasis being increased from removal of uterine scrapings for diagnostic purpose.

It has been my experience that the patient who has had the uterus curetted one or more times has not the life expectancy if malignancy existed that she would have had without such procedure.

That curettement of the uterine fundus is frequently an imperfect procedure, is often shown by a postoperative examination of the removed uterus.

Malignant tissue just beyond a benign tumor of the fundus is often missed.

Infiltrating or penetrating malignancy of the fundus can be very easily missed and the deeper portions of the malignant glands of both fundus and cervix may not be reached by curettage for diagnostic purpose.

In considering treatment of the malignant uterus the histology of the entire organ must be kept in mind. The mucous membrane of the fundus of the uterus

and the greater portion of the cervix are deeply penetrated by glands. The portio-vaginalis is without glands and it is my opinion that this histological fact may have a good deal to do with the favorable reaction of malignancy of the portio vaginalis to irradiation, as the growth in the portio vaginalis will remain as a superficial condition longer than would probably occur if its mucous membrane were deeply penetrated by glands.

To say that the uterus is benign or malignant is a very great responsibility to place upon the shoulders of even the most expert pathologists; especially is this so when the incriminating evidence may not be in the tissue that has been given in the uterine scraping.

I feel that many operators can report a greater percentage of operative victories or absences of recurrences in fundal malignancy than can be exhibited as percentage of accuracies by even a skilled pathologist from uterine scraping and I am not holding the pathologist culpable; he must be given the tissue from which to express his opinion. I have seen this failure very often.

I would like it understood that I hold no brief against scientific methods of investigation.

Many observers have classified the benign fundal tumors in accord with their amenability to irradiation.

Vaginal hysterectomy, clamp method, is fully illustrated in a monograph entitled "Practical Surgery of the Joseph Price Hospital."

Here again the uncertainty of radiotherapy comes in conflict with hysterectomy with almost a nil mortality in those tumors which can be removed by the vaginal route.

If the malignancy is confined to fundus and has not involved the cervix, which it rarely does, the prognosis is excellent. Operators can show 95 per cent of patients or better, living after five years. If the peritoneum of the fundus is involved then of course the prognosis is not so good.

THE FORMATION OF AN ARTIFICIAL VAGINA

A CONTRIBUTION TO THE 25TH ANNIVERSARY OF THE BALDWIN OPERATION*

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T is now a quarter of a century since Dr. J. F. Baldwin, of Columbus, Ohio, devised an operation for the formation of an artificial vagina. It is only since that time that relief has been extended to the unfortunate woman born without a vagina, or whose vagina has been destroyed by trauma. His method gives a vagina that is not liable to either contraction or permanent stricture. All previous attempts along this line had been failures. By his method he utilized a loop of the lower end of the ileum for the lining of the new vagina, or in rare cases, in which that portion of the bowel could not for any reason be utilized, the sigmoid flexure of the colon.

Later on Poposs, and then Schubert, suggested the formation of a vagina by utilizing a part of the rectum. The profession, therefore, has at its disposal the two methods; the one utilizing the small intestine as a rule, the other utilizing a portion of the rectum. The question is as to which of these operations should be considered the preferable one.

In 1924, I made an attempt to solve the problem and succeeded in collecting very complete records of patients who had been operated upon by one or the other of these methods, and I concluded that the Baldwin method bore the palm.

A careful study of all the available records which I have secured by further effort and persistence, has seemed to me to establish two facts: (1), that the Baldwin method is possessed of a whole series of advantages over that of the Popoff-Schubert, and (2), that it is impossible to consider the latter operation as having, as claimed by its proponents, only a merely nominal death rate.

Since 1924, my statistical data have become more complete, and I am now able to report 390 cases of formation of an artificial vagina. Of this number the vagina was formed from the rectum in 148 cases (31 according to the Popoff method, 117 according to the Schubert modification) with a fatal result in 12 cases. By the Baldwin method there were 242 cases with 28 fatalities. (Ten different surgeons reported by the method of Popoff; 56 by that of Schubert; and 127 by that of Baldwin.) My questionnaire enabled me to become acquainted with practically all the Russian cases, but with only a limited number of those in other countries.

The first thing to strike one in studying the material is that the Baldwin method had been utilized by nearly twice as many surgeons as the Schubert, and that while the formation of a vagina from the rectum has been employed in but a limited area (Popoff in the U.S.S.R. and Schubert in Germany), the Baldwin method has been used throughout the world.

The unprejudiced surgeon will clearly see that it is by far safer, from the viewpoint of asepsis, to work on the sound intestine enclosed in its peritoneum and freely movable than on the rectum devoid of any peritoneal coating and imbedded in connective tissue. The technique of Baldwin's operation is also exceedingly simple and elegant, while the Popost-Schubert method embraces some details which present certain technical difficulties, particularly that of circular resection of the upper end of the rectum, as acknowledged by Schubert himself.

Schubert also acknowledges that the gynecologists will prefer the Baldwin operation as this belongs to the type of operations with which they are most familiar, and that it will be difficult to show the advantages of the rectal method to the surgeon who has successfully used the Baldwin technique. Thus Frank, Brossman, Wertzeim, Martens and a number of other gynecologists who have used the two

methods have finally decided that the Baldwin method is to be preferred.

In order to secure the authoritative opinion of surgeons as to which of the two methods should be preferred, I laid the subject before the Russian Surgical Society of Pirogoff, November 9, 1927, at which meeting I demonstrated a patient upon whom I had operated by the Baldwin method. At this meeting not one of the surgeons spoke in favor of the Popoff-Schubert technique. Professor S. P. Fedoroff declared that he preferred the Baldwin method for two reasons: first, because of its easier technique; second, because it was followed by fewer complications. This view was concurred in by Prof. E. R. Hesse, Prof. J. J. Djanalidze and others.

Practically the only argument advanced against the Baldwin operation is its alleged high mortality. In previous articles I have attempted to show that this argument is by no means well-founded, and that the mortality of the Baldwin method does not differ materially from that of the method by utilization of the rectum. A thorough study and analysis of the fatal cases reported as following the Baldwin operation clearly show that the alleged mortality in most instances was not due to the operation itself but to clear failure in technique. So far as the causes of death can be ascertained from these reports, there were several deaths due to tension of the mesentery of the transferred loop of bowel with resulting loss of blood supply. In 3 cases operation was made upon tuberculous patients, even with tuberculous peritonitis. In at least 15 cases death was due to peritonitis, which of itself would indicate failure in technique, and in the autopsies following in most of these cases failure to make a proper anastomosis caused the fatality. In i of these cases the abdomen was reopened, and a twist of the mesentery was found where the anastomosis had been made, and the anastomosis itself had an acute angle. In another case autopsy showed that gangrene had resulted from the compression of the mesentery by closing too tightly

the opening through which the mesentery had been brought down into the vagina. In another, extreme tension of its mesentery was found to have been made in bringing down the intestine. At autopsy in another case relaxation of the anastomosis sutures was found responsible for the peritonitis. In I case, where the mesentery was too tense, the operator had made transverse incisions thus necessarily cutting off the blood supply. In another case the patient had had two previous abdominal operations (for appendicitis and volvulus) with extensive postoperative adhesions, and fatal tension of the mesentery followed. Two deaths are reported from anesthesia but no statement is made as to the length of the operation which had perhaps really been responsible for the fatalities. In 1 case, after incising the mesentery transversely to relieve tension, the operator was obliged to ligate "numerous bleeding vessels." In I case the anastomosis had been made so imperfectly that at autopsy ascarides were found crawling out. In one of the tuberculous deaths, occurring a month after operation, autopsy showed the field of operation to be normal, death being purely due to the pulmonary involvement. One death is reported (apparently from peritonitis) three years after the original operation but following the eighth operation made necessary because of ileus due to adhesions. Another death is reported six years after the original operation, a third operation having been made because of a persistent fistula which had followed a previous operation performed for ileus. One case is reported of death on the third day from peritonitis due to the transferred bowel having been so incarcerated as to have become necrotic. Five deaths are reported as due to causes unknown, there having been no autopsies.

From this statement it is very evident that in the large majority of deaths the fatality was due purely to faults in operative technique, or to anesthesia. Tension of the mesentery of the isolated intestine is noted in a considerable number of these cases, and such tension would necessarily result in interference with the blood supply or in separation of stitches. Careful examination of the bowel before detachment in these cases would have shown to the operator that dangerous tension would result and the sigmoid should have been selected instead, as distinctly specified by the originator of the operation; or if no loop could be found that could be utilized, and the mesocolon of the sigmoid was too short, the operation should have been abandoned.

The finding of tuberculous peritonitis, if the previous history had failed to establish that diagnosis, would in most cases absolutely preclude the operation unless the sigmoid were found free of involvement. One can only be surprised at the temerity of the surgeon who fails to consider the changes which he finds present but insists on completing the operation.

By excluding the deaths clearly due to errors in technique, the mortality of the Baldwin operation is reduced to 6.5 per cent or less, which closely approximates the 5 per cent mortality which Baldwin believes should be the limit, and is less than the 8.1 per cent of the Popoff-Schubert operation.

In Baldwin's original communication, emphasized in his subsequent publications, he refers to his operation as one of a plain, straightforward character, but one that should not be undertaken by surgical tyros or by anyone who is not thoroughly experienced in intestinal anastomosis. It would seem to be self-evident, also, that this is an operation in which repeated experiences would be of value in reducing the operation to its safest possibilities.

Six deaths have been reported following the Popoff operation: 1. On the third day there was a purulent discharge from the pararectal tissues, and on the fourteenth day a rectovaginal fistula with bilateral pneumonia. Post-mortem showed a purulent pararectal proctitis with pus extending to the left kidney and gangrene of the lung. 2. Death from sepsis ten days after operation. 3. Death on the second day; post-mortem showed acute pelvic peritonitis and the portion of the rectum sutured to the anus gangrenous. 4. Death from septic peritonitis four days after operation. 5. Death from peritonitis seven days after operation. 6. Death in twentyeight hours with weakened heart activity.

Deaths from the Schubert modification were: 1. Death nine months later after an attempt at closing a fistula into the bladder involving the urethra and sacrum. 2. Death from peritonitis three days after operation. 3. Death from sepsis on the third day. 4. Death from pelvic abscess (sepsis). 5. Death on the fourth day from severe sepsis. 6. Death on the fourth day from peritonitis and septic degeneration of the spleen.

It seems entirely evident that the Baldwin and Popoff-Schubert operations have essentially an equal operative mortality, but the Poposs-Schubert operation is likely to produce a series of severe complications which markedly decrease its value. Thus Popoff reports suppuration of the pararectal tissue with fistula formation; feeble sphincter ani, so that there was incontinence of feces and gas; a purulent passage between rectum and vagina with extensive and final complete necrosis, so that the new vagina and rectum made a common cavity with final complete loss of the vagina; on the seventh day a fistula into the pararectal tissue and a second one on the thirteenth day, the fistulae finally closing; several other cases with similar fistula formation; several fistula cases between the rectum and vagina, one at least remaining after a second operation made fifteen months later; shortening of the vagina from suppuration so that it was only 2 in. in depth. Other surgeons report similar failures necessitating repeated subsequent operations. A number report incontinence of stools and gas; one, a vagino-intestinal fistula.

Nearly 25 per cent of cases subjected to the Popoff-Schubert operation suffer from one or more of these complications, particularly the inability to retain gas and thin feces. From the frequency with which these complications occur it would clearly seem that they are necessary accompaniments of the principle of the method, and that the greatest caution together with the most perfect technique cannot always avoid them. The excessively fine manipulation of the rectum required within the region of the rectal tissues under conditions by which the operative field is inevitably contaminated with infectious material, and with insufficiently aseptic hands even when the gloves are frequently changed, all contribute to the formation of postoperative fistulae and other complications.

The presence of the abdominal scar by the Baldwin operation has been mentioned as a disadvantage, but such contention is too absurd to merit consideration, and such a scar is certainly no worse than the one which follows the Popoff-Schubert procedure: a scar on the back, particularly if connected with a resection of the sacrum, is certainly more undesirable than one in the linea alba.

In the Popoff-Schubert operation it has been sometimes found necessary to open the abdomen in order to secure enough tissue to complete the rectal operation, in which case the danger is greatly increased because of the immediate connection with an infected operative field.

The alleged excessive leucorrheal discharge following the Baldwin operation is largely mythical and probably invariably due to the employment of a superfluous amount of intestine. Correspondence with the originator, however, shows he has never had any such trouble, but he has always been careful to utilize only enough of the intestine to make a vagina of normal length. He also informs me that he has known of no case in which there was any postoperative stricture in the new vagina, or any other impediment to coitus.

Among my own patients there has never been a complaint of any permanent leucorrheal discharge, even a dose of physic producing no effect upon the vaginal secretion. No patient has complained of any form of dyspareunia.

The cases in which congenital absence of the vagina is associated with the presence of a functionating uterus are exceedingly rare, and while, when the uterus exists, the operation as originally advised by Baldwin should be so made as to permit of impregnation, that possibility is of only secondary importance, and if pregnancy should occur delivery of the child by Cesarean section if necessary would be a very simple procedure. If, however, the uterus is present the possibility of a normal delivery would be perhaps increased by using the sigmoid instead of the doubled ileum.

Conclusion: Thus we see that the Baldwin method presents no disadvantages as compared with the Popoff-Schubert, but on the contrary possesses a series of advantages over the latter which leads us to assign to it the first place and to consider it the method of choice. The advantages consist (1) in its being very simple and elegant; (2) it can be accomplised in a shorter time; (3) it allows the surgeon to work on the sound intestine with a peritoneal coating; (4) the vagina obtained by the method is so nearly normal as to be differentiated with the utmost difficulty; (5) there is no risk of incontinence of stools or a fecal fistula, so often observed as the result of the Popoff-Schubert operation; (6) it is much easier to observe the rules of asepsis and thus avoid septic infections; and (7) there is no resulting anal or rectal deformity. Thus, through the Baldwin operation we have been able within the last twenty-five years to aid hundreds of women, and by removing their terrible deformity to restore their peace of mind when they were not infrequently on the verge of suicide. The credit of the method which enables the surgeon, to whom the suffering woman turns with hope for relief, to effectually and without undue danger restore her to a normal condition should clearly be given to Baldwin.

THE MANAGEMENT OF

CHRONIC PELVIC INFLAMMATIONS*

Charles A. Gordon, M.D., F.A.C.S.

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MOWHERE is accurate diagnosis more desirable, more essential, than in the management of chronic salpingitis and its associated pelvic lesions. Salpingitis is hardly a good term, for only rarely is the lesion just that. Tubovarian disease is open to the same objection. Chronic pelvic inflammation is at least comprehensive; and, although it does not direct our attention to the essential salpingo-oophoritis, it is better, perhaps, that it does not.

Good treatment is based upon a thorough understanding of the possibilities of the invading organism, proper appreciation of the frequency of regression and arrest of the lesion, the selection of cases for prolonged conservative treatment, the futility of partial operations in some patients, and the necessity for radical operations in others. Conservatism may be carried too far, yet thoughtless removal of one or both tubes and ovaries carries with it some mortality, much unnecessary mutilation, and the most discouraging end-results.

Over 90 per cent of tubo-ovarian infections are caused by the gonococcus. Pyogenic organisms, the tubercle bacillus and the pneumococcus, play but a relatively small part. Salpingitis is a relatively infrequent form of puerperal infection, appearing usually after injudicious use of the curette in abortion, or following obstetrical operations in which the cavity of the uterus is invaded such as version or manual removal of the adherent placenta. These patients are apt to be the worst, getting well slowly or not at all; usually streptococcal in origin, the organism often remains alive in the tissues for years, giving rise to serious local sequelae and adhesions without clear lines of cleavage. Operation

may be done in these cases more readily, but only where the patient is reasonably safeguarded from undue risk.

The gonococcus, on the other hand, behaves differently. Its growth requirements, certainty of its early death, and knowledge of its long but sickly existence in the glands of Skene and the cervix, all speak for natural limitation of the infection. Operation should be done only for surgical treatment of sequalae which have defied all other forms of treatment. The infection may be managed by simpler procedures. Clinical improvement means cessation of bacterial activity within the tube: and exacerbations or recurrent attacks are never due to their regeneration, but always follow a new ascending invasion from the foci of infection in the external genitalia.

Removal of the adnexa without stamping out infection in every outpost of the invader is futile. The conservative operation will often be followed by a more radical one, and even panhysterectomy will not guarantee freedom from recurrent pelvic pain. If gonorrhea is as common as we are told,—and we know it is, and if it is the commonest cause of sterility,-and we believe it is, then it follows that most infections in women must result in absorption of tubal exudates, and complete recovery. Pregnancy is far too common to warrant any other conclusion. There is much evidence in support of perfect recovery, even when enormously swollen tubes have been felt or seen at operation. Acute or subacute tubes found when the abdomen of a young woman is opened for acute appendicitis should not be removed. Even low mortality never justifies that operation. The importance of preservation of proper ovarian function cannot be

* Read before a meeting of the Queensboro Surgical Society, Jan. 19, 1931.

overestimated, and it should not be forgotten that salpingitis is usually bilateral.

In the common absence of pelvic masses or the fixed uterus, diagnosis is made upon the history, and the stigmata of the gonococcus in the external genitalia. The importance of careful inquiry for typical urinary frequency, urgency and burning or stinging is obvious. Pain, discharge, dyspareunia, menorrhagia or amenorrhea are fairly constant. Palpation of adnexal masses is not at all essential. Smears are helpful but more often negative than positive. Diagnosis must never hang upon them for support.

Treatment should be all that we would wish it to be, were we ourselves the patients. That is true of any condition, of course, but, removal of ovary or tube, the commonest of pelvic operations, is often done for indications which are absolutely insignificant. Easy of access, simple to remove, so often suspected of complicity in all the ills to which poor female flesh is heir, they tempt the surgeon too boldly and so are summarily removed. Mortality is low. They are diseased. Convalescence is good. Why not remove them? Very little attention is paid to function, the most important consideration of all. Expediency, the real reason for most surgical intervention is by all odds the poorest argument. Women should be told that the slow arrest of the infection will be brought about by time and the natural development of immunity, that even two or three years is far preferable to ablation of organs which may be sorely missed, that operation can always be done if regression fails to occur, and that nothing is lost by delay, whether accompanied by proper treatment or not.

Operations should not be done in the acute or subacute stage, or even shortly after reinfection has subsided. Most gynecologists agree upon that. Although a few operators have achieved brilliant results this way, their case is not proved, nor can the average surgeon look for their low mortality, or expect anything but high morbidity.

Conservative treatment includes eradication of foci in Skene's glands and the cervix, abstinence from coitus, rest in bed for the first day or two of the menstrual period, anodynes for pain, occasional use of ice or heat.

The use of non-specific protein therapy is always worth while; although often disappointing it must be pushed to get results. Drastic cathartics are harmful, while glycerin enemas or gentle laxatives seem to act well. Pressure douches are distinctly harmful, while low douches, although their heat seems welcome, are not without danger too. I rarely use them.

Recurrent attacks of pelvic peritonitis are managed by Fowler position, fluids in every way possible, opiates freely, ice, and a small enema every other day. Peritonitis rarely spreads beyond the pelvis, and the pus-tube still more rarely ruptures. No vaginal or vulvar treatment should be carried on at this time. Occasionally abdominal or vaginal drainage of cellular tissue pus will be helpful.

Complete blood counts with occasional comparison of white and red cell counts and hemoglobin content help materially in estimating the severity of the infection and in measuring resistance. I have not found repeated transfusion of any considerable value in combating secondary anemia, but think much more of fresh air and sunshine, although use of the ultraviolet-ray for general surface radiation has been disappointing. Deliberate vaginal manipulation with careful observation of febrile reaction is a valuable criterion by which we may draw fairly accurate conclusions as to the coolness of the lesion, a simple test which involves no laboratory work.

The sedimentation time, however, is almost a specific test in determining the virulence of the infection and the best time for surgical intervention. More easily done than a blood count it is absolutely reliable, and can be depended upon as not misleading. It is probable that even slight reduction in the number of erythrocytes

will accelerate sedimentation time. So the test may show some error where anemia is a factor. It is not infallible when considered without the blood count, but is almost so, and for practical purposes is by all means the best test we have.

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Endometriosis and chocolate cyst should be remembered as the commonest lesion in the pelvis in women about thirty-five, often associated with fibromyoma. Dysmenorrhea, rectal involvement and nodular infiltration of the posterior vaginal fornix are significant. Densely organized adhesions are the rule.

Tuberculosis is usually encountered in those who have apical involvement with symptoms of pain, menstrual anomaly, and an adnexal mass. Intact hymen at least suggests the diagnosis.

It is not easy, I admit, to select cases of chronic pelvic inflammation for operation: much depends upon judgment and that, of course, is not infallible. I operate upon those patients only, who have a steadily increasing drain of menorrhagia, or persistent dyspareunia in spite of treatment, or more closely recurring ascending infections, or those who have easily palpable masses giving symptoms after two years, and occasionally others who are so disabled that they are unable to earn their living and carry out the details of prolonged treatment at the same time.

In general conservative operations are not advisable, another argument for deferring intervention if partial operation is contemplated. Ruthless removal, the clean sweep, is only too often found necessary. My experience with the Bell Buettner operation has not been good, except as a temporary expedient. If both tubes and ovaries are sacrificed, the uterus should be removed as well. If but one tube and ovary are taken, the uterus should remain in spite of its size, unless its peritoneal surface is so denuded as to invite future trouble. Omental grafts may be considered in this type of case. Ovarian transplants are almost without value, the ovary faring best when left where it is found. Yet it is my experience that surgical separation of the ovary from the tube, accomplishes much for function but little for the relief of symptoms.

In my own work, with a large amount of clinical material in the wards of two large hospitals, I have not thought or acted except conservatively for the last fifteen years. Many operations have been done, not always wisely, sometimes unnecessarily, never for expediency, and always after careful consideration of all the factors in the problem. End-results are difficult to appraise, but repeated review convinces me of the soundness of conservative treatment.

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*Continued from p. 470.

THE TECHNIQUE AND ADVANTAGES OF WORKING WITH THE OPEN DUODENUM IN STOMACH RESECTION FOR PEPTIC ULCER*

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OMAHA, NEB.

been made to solve a technique whereby the modern surgeon could perform gastrointestinal operations without the opening of the lumen, the results have not been satisfactory. After having served as an assistant in the von Haberer clinic, I am convinced that in stomach resections it is an advantage to work with a free wide open duodenum. As compared with the usual clamp method, I feel quite certain the incidence of peritonitis is not higher.

It is a matter of controversy as to indications and advisability of gastric resection in peptic ulcer, particularly duodenal ulcer and it is not the purpose of this paper to discuss this general question. Gastric resection has not only been criticized because of its higher mortality, which occurs because of the magnitude of the operation, but also it has frequently been stated that the percentage of permanent cures is no higher as compared with gastroenterostomy. From the number of patients with gastroenterostomies reoperated upon in the von Haberer clinic, I feel that the last statement is not correct. If in a reported series of cases the incidence of poor results is shown to be as high in resection as in gastroenterostomy, the faulty factor may not be in the principles of the operation but in the fact that the duodenal ulcers were not removed at the operation. As regards poor results, I particularly refer to so-called recurrent ulcers. The method of working with the open duodenum as used by Prof. von Haberer materially increases the possibilities of seeing and removing difficult duodenal ulcers.

The operation of choice in the clinic is

the Billroth 1 and without using clamps one is able to perform this operation more frequently. By means of the end to end

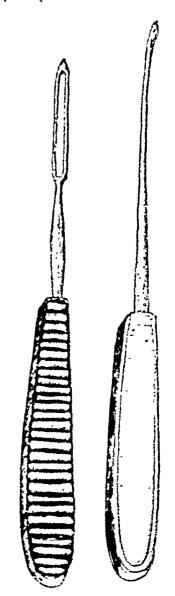


Fig. 1. Special fine perfor ted desectors sound with a curve modelle to noteb.

anastomosis the stomach empties directly into the duodenum whose mucous membrane and alkaline fluids are particularly adapted to the handling of the acid contents of the stomach. Naturally, marginal

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ulcers can less frequently complicate the operation. The direction of flow of intestinal contents is maintained and mechani-

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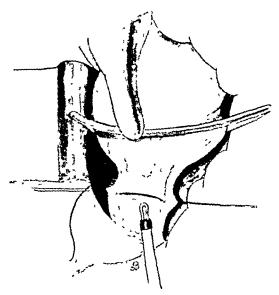


Fig. 2. Duodenum has been mobilized. Guide sutures are placed to control duodenum, avoiding use of clamps. Duodenal ulcer is present on anterior wall above line of cautery incision.

of a Billroth 1. Further, only one segment of the gastrointestinal tube is disturbed, eliminating opening of the jejunum and secondary symptoms from surrounding adhesions and angulations. The danger of herniation into the transverse mesocolon is also eliminated.

Briefly, the technique in resection is carried out in the following manner. The right gastric and right gastroepiploic arteries are doubly ligated and cut. By means of very fine instruments (Fig. 1), repeated small bands of tissue are doubly ligated and the tissue cut between the ligatures. The tying off and freeing of repeated strands of tissues on all sides of the duodenum gradually mobilizes the duodenum. Adequate mobilization of the duodenum, exact hemostasis and minimum tissue damage are most important. A normal serosa on the posterior surface of the duodenum is an absolute prerequisite for a Billroth 1. The ligations of the gastrohepatic and the gastrocolic omenta are

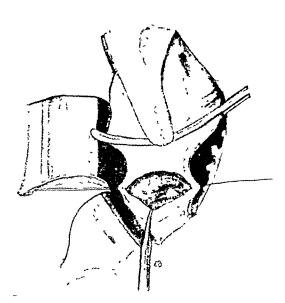


Fig. 3. Anterior wall of duodenum has been opened and posterior wall of duodenum is being examined. There are two ulcers present. It is probable lower ulcer would not have been seen or removed by clamp

cal complications are less to be feared. Prof. von Haberer has never seen stricture of the duodenum following his technique

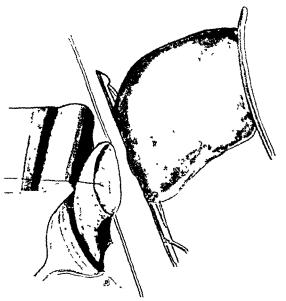


Fig. 4. Free duodenum is further examined. Small piece of gauze attached to string has been inserted into duodenum to prevent regurgitation. Clamp has been placed on stomach and is being brought into approximation with duodenum.

then completed. A Doyen clamp is placed just above the pylorus and the peritoneal cavity packed off with gauze. The pylorus

is grasped between the thumb and two fingers of the left hand and slight tension made. Guide sutures are then placed on the upper and lower margins of the duodenum at about the planned level of severance (Fig. 2). These guide sutures are not tied but held slightly taut by an assistant. They serve to control the duodenal stump and thereby avoid the necessity of a clamp. A clamp on the duodenum not only traumatizes the tissue but also prevents the operator from seeing ulcers on the posterior wall which may be included in the clamp or are below the clamp. Without doubt, it is more frequently possible to do a Billroth 1, the most physiological-anatomical operation, when no clamp is used on the duodenum. By means of an electric cautery, the anterior wall is severed on a line below the level of the ulcers (Fig. 2). Usually a very small amount of duodenal contents escapes but this is quickly sponged away. The mucosa of the posterior wall of the duodenum is carefully inspected (Fig. 3). A small sponge on a string is then inserted into the duodenum to prevent any regurgitation of duodenal contents. The cautery then cuts through the posterior wall and by direct inspection the line of incision can in most instances be carried below the ulcers. With a clamp on the duodenum one does not only fail to see these posterior ulcers but also fails to remove them. If a duodenal ulcer cannot be removed, the Billroth 2 becomes the operation of choice.

Occasionally a posterior ulcer has penetrated into the pancreas and the tissue above and below the ulcer can be separated. The adherent perforation is burned off of the pancreas with a fine cautery, avoiding if possible opening of the ulcer. The area is further cauterized and covered with pancreatic capsule.

The stump of the duodenum is again closely inspected (Fig. 4). If a normal

serosa is present on the posterior surface of the duodenum, a Billroth I is carried out. Occasionally the posterior wall of

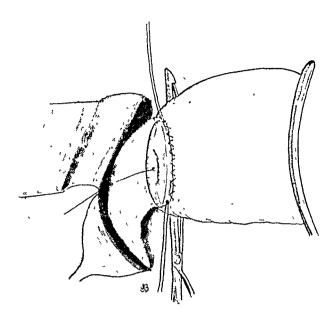


Fig. 5. Layer of interrupted Lembert sutures has been inserted securing stomach and duodenum. Anastomosis is then completed according to technique of Prof. von Haberer.

the duodenum is too short to make a safe anastomosis and rarely there occurs too much tension when the stomach and duodenum are approximated. An anterior Billroth 2 with an enteroenterostomy is then the operation of choice.

CONCLUSIONS

Provided that resection has been decided upon, working with the free open duodenum offers an excellent means to see and remove ulcers of the duodenum which many times are concealed in the closed clamp method. Another very important advantage is that the thin walled duodenum is not traumatized by a clamp. Further, the end to end anastomosis is the most physiological-anatomical operation and by working with the open duodenum, it can be performed more frequently and with less difficulty.

INTESTINAL OBSTRUCTION

DUE TO HERNIA IN DUODENOJEJUNAL FOSSA*

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BECAUSE of their rarity, peculiarity of anatomical features and the difficulty of establishing a preoperative diagnosis, internal or retroperitoneal hernias are of especial significance to the surgeon. Up to the end of 1928, Garber reported, from a series of 134 cases, only 5 which were diagnosed prior to operation or autopsy

CASE REPORT

A. L.; female, aged seventy-eight years, was first seen May 18, 1930, complaining of generalized abdominal pain accompanied by vomiting and constipation of nine days' duration. There was no jaundice. Very little flatus was passed. Urinary symptoms were absent. There was no cough or loss of weight. Temperature was normal during this entire period.

The family history was negative as to malignancy and tuberculosis. The patient had had no miscarriages.

There was a definite history of attacks of indigestion, upper abdominal pain, vomiting, abdominal distention and constipation for the last twenty-five years. She had never noticed any evidence of tumefaction in the abdomen; nor had she ever had a serious illness or operation. The climacteric occurred at the age of forty-eight.

Physical examination showed a female, about seventy-eight years of age, who appeared toxic and dull. Breath was foul smelling and the tongue dry. Pulse rate was 120 per minute, temperature 104.2°F., and respirations 24. Superficial lymph nodes were not palpable. The heart and lungs were normal. Blood pressure was 80 systolic and 50 diastolic. The abdomen was distended and there were no tumor masses seen or palpated. Peristaltic or antiperistaltic waves could not be detected. There was definite rigidity of the abdomen and an indefinite resistance felt in the left hypochondrium. Vaginal and rectal examinations were essentially negative. The knee jerks were not elicited.

The patient's poor physical condition precluded the taking of a blood count and urine analysis. She was taken immediately, upon admission to the hospital, to the operating room, the diagnosis being intestinal obstruction.

The abdomen was opened by one of us (J. A. L.) through a 412 in. right upper rectus muscle splitting incision. A quick search revealed the liver, stomach and gall bladder normal. With the exception of dilated loops of small intestine, nothing was seen or felt in the abdomen on general exploration. Since we knew that a lesion must be present, a rapid evisceration was performed upon hot towels and upon following the dilated loops of small intestine it was soon discovered that they led to a pocket in the fossa of Treitz. Ten feet of cyanotic gut were withdrawn from the pouch. This was wrapped in hot towels and after fifteen minutes the establishment of good circulation was accomplished. The mouth of the pocket was obliterated with 2 interrupted catgut sutures. Following the release of the incarcerated intestine the abdomen was closed in layers. The operation was performed under spinal anesthesia and during its entire course a small duodenal tube, introduced through the nose, was left in the stomach and considerable intestinal contents evacuated. The patient was sent back to the room with this tube in situ. Fluid was forced by skin, rectum and through the duodenal tube.

Several hours later the patient suddenly went into collapse, the temperature rising to 108°F. and died. Autopsy could not be obtained.

Certain recesses or peritoneal pockets are normally present within the abdominal cavity which merit interest because of their capability of causing internal hernias. The largest of these is the omental bursa; the others falling into 3 groups, namely: duodenal, cecal and intersigmoidal. The duodenal fossa is subdivided into (a) the inferior duodenal fossa (b) the superior duodenal fossa (c) the duo-

^{*} Submitted for publication February 13, 1931.

denojejunal fossa or fossa of Treitz. The last-named is the one with which this paper is concerned.

This fossa can best be seen by pulling the transverse colon upward and pushing the jejunum downward and to the right. It is bounded on the right by the abdominal aorta, on the left by the left kidney, above by the pancreas and below by the left renal vein. It is normally 2 to 3 cm. deep and its orifice, directed downward and to the right, is nearly circular and will admit the tip of the little finger.

Studies of duodenojejunal hernias have all been based on the original investigations of Treitz who explained the occurrence of these peritoneal recesses or pockets on the basis of a failure of complete fusion of the peritoneal leaf during the process of rotation of the various parts of the alimentary tract from the straight vertical tube stage of early embryonic life to the definitive position assumed by the various components of the alimentary tube in later fetal life. The anatomico-embryological construction of the duodenojejunal fossa has further been studied by Journesko, Bender and Lukianow, 1 Moynihan, 2 Andrews,³ Gruber,⁴ Landzert,⁵ Eppinger,⁶ Waldeyer,⁷ Broesike,⁸ and Eisler and Fisher.9 These observers have described various pockets in the fossa of Treitz which make the subject a bit confusing. There are 2 locations however which are significant as regards the formation of Treitz's hernia: that is the upper horn of the duodenojejunal fossa carrying the inferior mesenteric vein and the lower horn in which according to Broesike the so-called mesocolic recess occurs.

Andrews believes that Treitz's hernia is due to a congenital anomaly in the development of the peritoneum. Basically the anomaly results from a developmental and rotational restriction of the duodenum and intestinal loops, as a result of which there occurs a false position of the intestinal loops which prevents the formation of normal adhesions of the mesentery with the posterior parietal peritoneum resulting

in the formation of large pockets or hernial sacs. The supposition of Treitz and Wolms that the duodenojejunal fossa may distend from the pull exerted by the intestine to such a degree as to form a true hernial sac has been doubted by Garber in the light of recent embryological knowledge.

Indisputable signs in the recognition of duodenojejunal hernia other than the position of the inferior mesenteric vein are the anatomical position of the hernia, the size of the sac and its content, usually a large portion of small intestine.

A correct preoperative diagnosis is exceedingly difficult to make as is borne out by the fact that only 5 cases were correctly diagnosed; (1) by Abraszow, (1) by Vautrin, (1) by Staudenmeyer, and (2) by Haberer. These have been established either by operation or necropsy.

Garber considers the following symptoms of a Treitz hernia as very suggestive:

- 1. Dyspeptic phenomena such as constipation, diarrhea, and a sense of heaviness in the abdomen.
 - 2. Periodic distention of the abdomen.
- 3. Sensation of an elastic tumor in the left hypochondrium.
- 4. Tympanitic resonance abdomen.

In the acute stage the signs of ileus with the presence of a palpable tumor in the left hypochondrium help to establish the diagnosis. In any intra-abdominal crisis if one would always consider the possibility of internal hernia, incorrect diagnosis and subsequent improper treatment would be avoided.

In the treatment of these hernias the sac should be resected if the vessels permit, followed by obliteration of the hernial orifice with sutures. After removing the hernial contents, all that is necessary, at times, is to close the aperture with a few sutures. The prognosis depends upon the interval elapsing between the onset of symptoms and the institution of treatment. Operation, performed early, warrants a good prognosis.

[For References see p. 538.]

A CLINICAL DISCUSSION OF

NON-ROTATION OF THE LARGE GUT

WITH REPORT OF TWO CASES*

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ASE 1. Dr. Stetson attended W. B., a sixteen year old boy through three mild abdominal episodes within a

porary relief of abdominal pain followed. The doctor was finally able to persuade the parents to accept his diagnosis of appendicitis



Fig. 1. Complete non-rotation of colon. Barium enema.

period of three months. On each occasion there was a history of indiscretion in diet. There was no history of attacks prior to his first observation of the case. The cramp-like pain was on each occasion local from the start, and located about midway between the umbilicus and the symphysis pubis in the midline and about equally across the lower abdomen both to the left and to the right of the midline. No definite local point of maximum tenderness could be elicited. Each attack lasted about thirty-six hours. The first two were afebrile. In the third attack his temperature reached 99.4°F. by mouth. Pulse ranged in the eighties. He vomited once with each attack, about three hours after the onset of pain and tem-

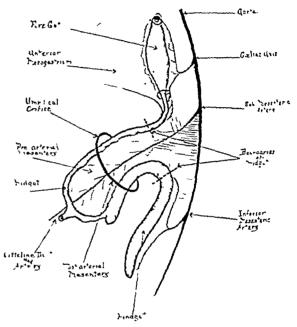


Fig. 2. Conditions of primitive alimentary tract at fifth week. The three main subdivisions are seen to constitute three loops—foregut, midgut and hindgut. Aorta is representative of axis of body. From it the three loops are suspended by their common mesentery, in sagittal plane. In mesentery special arterial blood supply for each loop is represented. Midgut loop is already large and has been extruded into umbilical cord. The cecal bud is appearing.

Pre-arterial mesentery is indicated by vertical shading. Postarterial mesentery is indicated by horizontal shading. (From Fig. 179, p. 253. Dott, N. M. Anomalies of intestinal rotation. Brit. J. Surg., 11: 251, 1923–1924.)

and the patient was admitted to the New Haven Hospital May 25, 1930.

On admission, temperature, 99°F., pulse 84, white blood corpuscle count, 14,600. Seventynine per cent polymorphonuclears. There was an area of tenderness just to the right of the midline 2 in. below the umbilicus. The right rectus was more resistant than the left in its

* I am indebted to Dr. Paul R. Stetson for the privilege of using the first case herein recorded and whose roentgenogram is Fig. 1. The other case occurred some years ago. Submitted for publication February 13, 1931. lower segment. There were no bladder symptoms. The abdomen was uniformly tympanitic. An enema in the afternoon had yielded a good

up and followed down for about a foot. It was freely movable on a long mesentery. It did not cross the spine. It was not fast to the

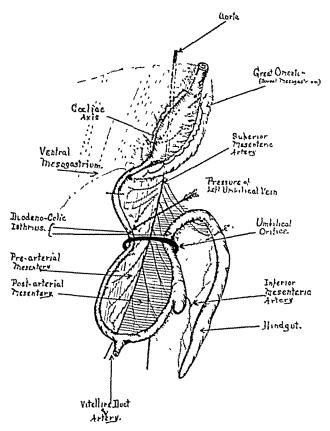


Fig. 3. Same stage as preceding figure, viewed from ventral aspect. Same points are brought out. Note especially right-sided position of small intestine and left-sided disposition of large at this early stage of rotation process. In condition referred to as "non-rotation" these relations are maintained. (From Fig. 172, p. 255, Dott, N. M. Idem.)

result (mother's statement). There was on reason to suspect that the appendix occupied any but the usual position in the abdomen.

A McBurney incision disclosed only a mass of small intestines. Following the parietal peritoneum down from the wound across the psoas muscle failed to locate a mesocolon. We arrived at the spine. Search upward, through the extended original incision, exposed a normal gall bladder. The greater curvature of the stomach was brought into the wound and presented a curious appearance. It was entirely devoid of gastrocolic mesentery from the pylorus to a point well to the left of the midline of the greater curvature. The vessels of the greater curvature were small and the spaces between those visible on the anterior wall of the stomach were much wider than usual. Nothing abnormal was noted in the lesser curvature. The duodenum was picked

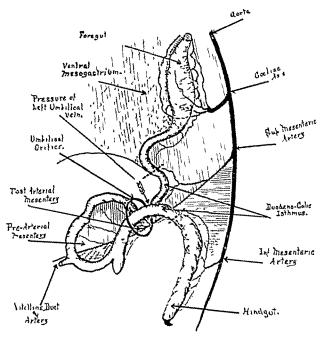


Fig. 4. Representing conditions of alimentary tract about eighth week. First stage of rotation is being accomplished. Arrow indicates pressure being exerted by left umbilical vein on pre-arterial loop, forcing it downwards and to right. Note narrow duodenocolic isthmus at base of loop, with superior mesenteric artery running through it. (Copied from Dott. Idem.)

spine. I did not examine the foramen of Winslow.

Reaching across the abdomen I was unable to find any great omentum. I could feel something attached to the extreme left of the greater curvature of the stomach but could not bring it into view. I could not identify a transverse colon.

Shifting to the pelvis, the cecum was found deep in the hollow of the sacrum in about the midline. That is the ileocecal valve was about in the midline but the bulk of the cecum occupied the left pelvis. The ileum entered the cecum from the right side instead of entering from the left as is usual. The appendix was rather longer than usual but otherwise appeared quite normal on the outside. Its mesentery was free as was that of the cecum which delivered into the wound easily. The vessels appeared quite as usual.

Routine appendectomy and wound closure. Uneventful convalescence.

Pathological Note: Cross-section. The specimen consists of an appendix which measures about 11 cm. in length by 7 mm. in greatest diameter. Throughout it is fairly uniform in size. The serosa presents a grevish appearance.

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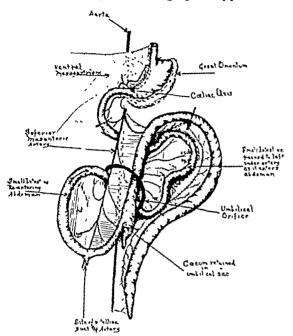


Fig. 5. Conditions of alimentary tract at tenth week. It will be seen that the pre-arterial segment of the loop—the small intestine—has increased in length disproportionately to post-arterial segment, and that its mesentery has shared its rapid growth. Cecum and adjacent colon have grown relatively thick. Temporary umbilical hernia is in process of reduction. Small intestine is seen entering abdomen on right side of superior mesenteric vessels and passing to left side of abdomen behind mesenteric vessels to fill up available space. Vessels are held forward to umbilicus by cecum, which still lies in sac. Second stage of rotation is in progress. (Copied from Dott. Idem.)

It does not appear particularly congested. When opened longitudinally the lumen of the appendix is seen to be patent throughout. No fecaliths are present. The wall appears to be the usual thickness. The mucosa presents a somewhat greyish surface. Sections taken for microscopic examination. Dr. Claiborn.

Microscopic. Sections of the appendix show a mucosa, the epithelium of which is absent in areas. The submucosa is infiltrated heavily with round cells and the germinal centers of the lymph follicles are large, with clear cells. The muscularis and serosa are not abnormal in appearance.

Final Diagnosis: Vermiform appendix, No. pathological diagnosis. Dr. Lindskog.

The roentgenogram was made about a month after operation.

Subsequent questioning failed to elicit any history of abnormal abdominal sensation, bowel movement, or particularly any indication of

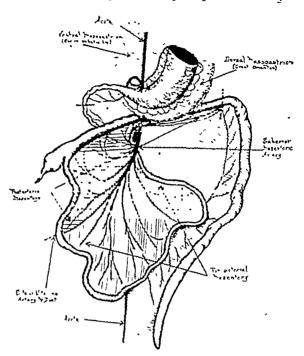


Fig. 6. Conditions of alimentary canal about eleventh week. Second stage of rotation is complete—cecum is now in contact with posterior abdominal wall in right loin. It will now be seen that midgut loop has rotated on axis of superior mesenteric vessels through 270° from its original sagittal plane. Essentials of permanent disposition of viscera have been attained. (Copied from Dott. Idem.)

partial obstruction. Six months after operation there was no abnormality found on physical examination.

Mayo has called attention to the possibility of determining the left-sided location of the colon by percussion. In this case knowing that the colon was so located it was possible to demonstrate an increased area of tympany on the left side with a less resonant right lower iliac area. This left-sided area of resonance varied a good deal however. Shortly after a stool it scarcely exceeded the usual limits of descending colon tympany in the average individual. When the large gut was distended the increase in the extent of this tympanitic area was quite marked, extending occasionally as far as the midline. The right iliac percussion note naturally re-

mained unchanged. As far as this particular case is concerned then, and no further (for this is the only case that I have had the opportunity to study, it appears that: the finding of an increased left-sided tympany at a single examination is more or less a matter of chance; 2, the finding on repeated examination of a variable and at times markedly increased area of left-sided tympany, below the umbilicus, associated with a constantly present relatively dull area in the normal location of the cecum in the right iliac fossa is suggestive of non-rotation of the large bowel. Definite diagnosis is readily attained by x-ray examination.

Lon W. Grove of Atlanta¹ reports a case in a male twenty-seven years old, with a history of abdominal pain and diarrhea, definitely related to meals, and persisting since infancy. Grove diagnosed the condition, adjusted the colon over into its normal position, and got a symptomatic cure. He does not publish the x-ray plates taken after operation. Presumably the anatomical situation was materially altered. He attributed the persistent symptoms to mechanical irritation caused by adhesions between the duodenum and the nonrotated colon.

Ordinarily the condition of non-rotation of itself is symptomless. There is however an increased liability to intestinal obstruction due to volvulus chiefly, and occurring in about one-half the number of cases during the first few days of life. Dott especially calls attention to this situation as a more frequent cause of intestinal obstruction in the first few days of life than is generally appreciated. Of 13 cases of malrotation in which the condition gave rise to symptoms 6 occurred in the early postnatal period; 7 developed obstruction in after years. The remaining 35 of a total of 48 cases which Dott collected, including 3 of his own were discovered accidentally. They were symptomless.

CASE 11. Anna C., aged sixty-five, single. ¹ Ann. Surg., 91: 615-618, 1930.

Was admitted to Grace Hospital Oct. 16, 1919, with an acute intestinal obstruction of two days' duration, and a history of obstinate con-

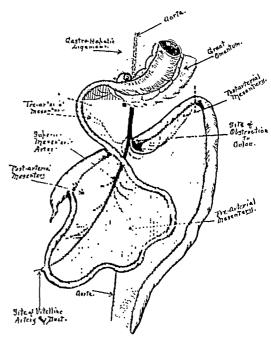


Fig. 7. Reversed rotation of midgut loop. Midgut loop has rotated in clockwise direction through 90°, from original sagittal plane. Thus colon is brought to lie behind mesenteric vessels and duodenum in front of them. These are the only noticeable defects, viscera otherwise attaining normal positions, though of course their anterior and posterior surfaces are reversed. (Copied from Dott. Idem.)

stipation which had existed "always," and which produced frequently recurring attacks of pain and vomiting relieved by enemata and laxatives. The site of the obstruction was found in the lower reaches of the ilium "about 2 ft. from the ileocecal valve." Here the gut was fast to the posterior abdominal wall by its mesentery of no length. The leaves of the mesentery here attached formed an arch under which the small intestine had crawled, jamming a coil of gut in the acute angle formed by the faulty attachment of mesentery to the posterior abdominal wall "to the left of the spinal column." Compression of this loop was visible and there were 4 small hemorrhagic areas on the peritoneal surface of the bowel at the point of constriction. The constriction relieved by mobilizing the deficient mesenteric attachment of the terminal ileum permitted the collapsed terminal ileum to fill readily. But it was then found that the mesentery itself was twisted clockwise through 180° or more and it was necessary that "the entire small intestine be rotated from the left to the right side"

(anticlockwise) of the abdomen through 180° to accomplish "the straightening out of the mesentery." (The quotations are from my own

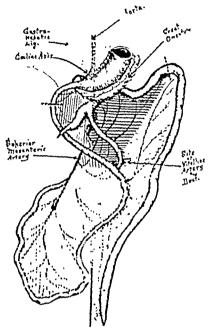


Fig. 8. Malrotation of midgut loop. Reversed rotation of pre-arterial segment through 90° in clockwise direction. Arrested rotation of post-arterial segment. Mesentery is folded over as on a hinge, at line of superior mesenteric artery. (Copied from Dott. Idem.)

operative records.) This case was probably an early stage of volvulus superimposed on nonrotation for at the conclusion of the operation there were small intestines lying to the right of the cecum. This patient made an uneventful recovery and some seven years later died of pneumonia. Her constipation persisted.

The accompanying diagrams together with their legends need no additional explanation to make clear the conditions obtaining in malrotation of the colon. A clear concept of these conditions would have been invaluable to me in 1919. Based thereon the surgeon confronted unexpectedly with an obviously anomalous abdomen can greatly expedite his work both in interpreting and meeting the particular indications of the problem in hand. Moreover these patients should be appraised of the existence and character of their anomaly and told that they are more likely to develop intestinal obstruction than is the general run of mankind. In this manner they are safeguarded against an unwelcome and unusual hazard of life.

Reference to the figures will make it apparent that finding himself engaged in an anomalous abdomen the operator will naturally turn his attention to two pertinent observations:

1. The relation of the duodenum to the origin of the superior mesenteric artery. Does the duodenum pass under the artery, fast to the spinal column, and is it retroperitoneal? Or does it lie free in the abdomen, with a mesentery, wholly unrelated to the origin of the superior mesenteric, and continuous with and indistinguishable from the jejunum?

2. Does the transverse colon pass under the origin of the superior mesenteric artery as in Figure 7, or does it not?

These are the key points in determining the variety of malrotation present.

It is beyond the purpose of this article to discuss the embryology or mechanics of the production of these faulty rotations of the colon. To those interested I recommend the study of the original article by Norman M. Dott of Edinburgh,1 from which the accompanying diagrams were copied.

1 Brit. J. Surg., 11: 251-286, 1923-1924.



SPONTANEOUS RUPTURE OF THE ESOPHAGUS

FOLLOWING VOMITING*

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TOLED

HE following case is reported because of its rarity and because ing that serious injury to the esophagus may result from severe vomiting. Moreover, the fact that the marked abdominal symptoms present led, as in many other recorded cases, to laparotomy, should attract the attention of the abdominal surgeon. Most of the cases, in the literature, of actual rupture of the esophagus have been in men but Vinson of the Mayo Clinic²⁷ has reported o cases in which, as the result of the vomiting of pregnancy, serious damage has been done to the lower esophagus. All of his patients who recovered, developed strictures in the lower third of the esophagus. Two of them died, one from an abscess of the mediastinum and the other from an esophageal hemorrhage. Still another developed a periesophageal abscess and recovered following drainage into the esophagus. The vomiting of a dark, bloody material was a prominent symptom and most of the patients complained of a substernal pain. It is certain that Vinson's cases were the direct result of the vomiting of pregnancy. Two factors seem to have been responsible for the trouble. The first was direct mechanical trauma to the wall of the lower esophagus, which, in the case to be reported in this paper, resulted more seriously in the actual rupture of the esophagus. The second factor was described by Zenker48 and Von Ziemsen in 1878 as esophagomalacia. It was their belief that as the result of vomiting the lower esophagus is exposed to the prolonged chemical and digestive action of stomach contents and the reaction thus induced, especially in weakened individuals, predisposes to more serious results from inflammation and trauma.

The case which led to this report was that of an active business man aged fifty.

For ten years this patient had had all the usual symptoms of duodenal ulcer. The diagnosis had been confirmed by definite x-ray findings. He had also had a stricture of the lower esophagus which had caused considerable difficulty in swallowing. In spite of these conditions he had been quite comfortable and had been gaining weight.

At seven o'clock on the morning of February 3, 1928, the patient began to have abdominal pain and vomited strenuously for the following two hours but was able to bring up only a small amount of blood. Suddenly at 9.00 A.M. he experienced a very severe pain in his epigastrium and left lower thorax. He was not relieved by ½ grain of morphine.

When seen at 12.00 noon he was in great distress. The whole abdomen was hard and extremely tender in the epigastrium. His breathing was difficult and he groaned constantly. He was lying doubled up on his left side with his thighs flexed. His temperature was 100°F., pulse 120, systolic blood pressure 120, diastolic 75, and respirations 30. The red blood count was 4,500,000, hemoglobin 70 per cent white blood count 8800, with polymorphonuclear cells 70 per cent. The urine showed albumin 180 mg. per 100 c.c., sugar negative, and acetone positive. Examination of the chest showed no definite pathology except what might be explained by a recent cold. There was no emphysema of the neck at any time during the illness.

In the light of a definite history of duodenal ulcer a diagnosis of an intra-abdominal perforation was made and the abdomen opened. There was no perforation of the stomach or duodenum. There was, however, a volvulus of a loop of the lower ileum causing an acute obstruction. The pylorus was markedly constricted by the old ulcer and the dilated stomach distended with about 3 qt. of fluid.

The following day he was much worse. There

^{*} Read at the Forty-third annual meeting, American Association of Obstetricians, Gynecologists and Abdominal Surgeons, held at Niagara Falls, September 15, 1030.

was no vomiting but he was restless and in shock and perspiring profusely. He complained of pain in his chest and of labored breathing with inability to take fluids by mouth or to clear mucous from his throat. His temperature was 103°F., pulse 140 and respirations 40. There was now a definite pneumothorax on the left side and the heart was displaced to the right. The breath sounds were diminished throughout the left chest and there was fluid dullness in the left thorax posteriorly. He died at 9.00 P.M., thirty-six hours after the onset of his severe pain.

A post-mortem examination, fifty minutes after death, showed a greatly distended small bowel and a loop of gangrenous ileum. The pylorus was stenosed. The left lung was collapsed and the pleural cavity filled with a thin, brown fluid with a fecal odor. The pleura was covered with exudate and greatly inflamed. There was a stricture of the esophagus 5 cm. above the diaphragm with an internal diameter of 4 mm. Between the stricture and the diaphragm there was a complete rupture of the esophagus 2 cm. long connecting the lumen of the esophagus with the mediastinum and left pleural cavity. The fluid in the left pleura contained many gram-negative bacilli, streptococci, staphylococci and gram-positive diplococci. The right lung was completely adherent to the chest wall, effectively preventing rupture into the right pleural cavity. The patient also had a chronic interstitial nephritis and an early coronary sclerosis.

The esophagus above the stricture was normal except for one area of chronic inflammation in the submucosa. Just below the stricture there was quite normal stratified squamous epithelium but still lower toward the rupture, a denuded area with a smooth base of dense fibrous tissue showing marked chronic inflammation. Below the rupture the epithelium showed glands resembling those of the stomach but less developed. A transverse section taken at the level of the rupture showed a mucosa with glands resembling gastric glands. A little away from the edge of the rupture there was an area denuded of epithelium. The mucosa and submucosa and muscularis showed a chronic inflammation. At the edge of the rupture there was some necrosis and a deep laceration in the mucosa extending away from the rupture. The outer layers of the esophagus and surrounding connective tissue showed an acute inflammation. The cardia and fundus of the stomach

showed chronic catarrhal inflammation and erosion of the mucosa and thickening of the submucosa.

The sequence of events is as follows: The primary vomiting was initiated by the volvulus of the ileum. The distended stomach could not quickly empty itself because of strictures in the pylorus and esophagus. The fluid from the stomach was therefore forced by vomiting into the lower esophagus and being unable to pass the stricture, was driven through the chronically diseased esophageal wall into the mediastinum and left pleural cavity. The adhesions of the right lung to the chest wall prevented a rupture into the right pleura. Death was due to shock, intestinal obstruction, and acute infection of the mediastinum and the left pleura.

The first case of rupture of the esophagus from vomiting was reported in great detail in 1724 by Boerhaave, and the second in 1788 by Dryden, 11 a military surgeon in Jamaica. Fitz12 in 1877 reported a case and reviewed the literature to date. He rejected a number of cases, which were undoubtedly authentic, on the basis that they were due to post-mortem digestion. It has been rather difficult to disabuse the minds of the profession on this point but the occurrence of some 30 cases, since that time, under such similar circumstances and with such uniform symptoms and physical signs, has made the argument of less value. Sir Morell Mackenzie28 reported a case in 1886 and fully discussed the subject, reviewing the cases to date. In 1900 Bowles⁶ and Turner collected 18 cases and reported 1 of their own. In 1914 Irving J. Walker 40 found 22 cases including I of his own. He excluded 10 cases, many of which could well have been accepted. A bibliography of all cases to date is appended to this paper.

One must reject from this group cases of rupture of the esophagus from such causes as tuberculous bronchial glands, pyogenic mediastinal abscesses, carcinoma, lues, aneurysms, direct trauma from foreign bodies, diverticula, acute gangrenous stomatitis, and chemical burns.

The etiology of this accident is now clear and well established. A patient with a full

stomach vomits or retches violently and ejects fluid into the esophagus with such force and such suddenness that the pressure cannot be relieved quickly as it usually is by the escape of fluid through the esophagus. The force is therefore exerted against the walls of the stomach and esophagus, and a rupture occurs at the weakest point which is the lower end of the esophagus. Mackenzie removed the esophagus at some 18 post mortems and produced rupture by water pressure and found that rupture occurred in all but I in the lower third under a pressure of from 5 to 11 lb. The rent was always longitudinal, the muscle giving away first and finally the

As explained before, it is not necessary to presuppose any obstruction of the esophagus during vomiting as a cause of rupture. In several cases, however, rupture occurred while the patient was making a violent effort by retching and coughing to dislodge a piece of meat from the gullet and in 2 cases, including the 1 reported in this paper, the accident occurred with vomiting in the presence of an esophageal stricture. The musculature of the lower esophagus is largely voluntary and that in the lower end is involuntary. It is probable that a spasm of the circular voluntary fibers of the upper esophagus during vomiting or even a lack of their coordination with the muscles of the lower esophagus might cause an obstruction during the act of vomiting. Again, the unyielding nature of pharyngeal outlet between the cricoid cartilage and the sixth cervical vertebra may be a point of relative obstruction during vomiting.

Whether an absolutely normal esophagus can be ruptured by vomiting under the conditions just described is difficult to prove because of the condition of the organ when examined post mortem. Nevertheless, in many of the cases reported there is every reason to believe that the esophageal wall was of normal strength before rupture. It is not unreasonable to believe that a pressure of from 5 to 11 lb., found neces-

sary to rupture the normal esophagus, could result from severe straining and vomiting. Undoubtedly, the strength of the esophageal wall varies in different individuals. The organ, too, may be weakened by scars, strictures, dilatation, ulceration, chronic inflammation, such as that of alcoholism and that following prolonged vomiting and regurgitation. Fitz¹² in 1886 made the following statement: "There exists the certainty that a previously healthy oesophagus may be suddenly ruptured by muscular action."

The rupture of the esophagus may extend only into the mediastinum with acute mediastinal cellulitis or abscess formation. Usually, the tear extends through the mediastinum and pleura into one or the other pleural cavities, more frequently the left. When this occurs the lung on the affected side soon collapses and the pleura becomes the site of an extensive and virulent inflammation comparable to a general acute peritonitis. Death is largely due to sepsis from this cause. When the rupture is into either pleural cavity the mediastinum is always involved, as the path of the rupture must pass through the mediastinum. The infection of this space is therefore added to that of the pleural cavity. When the rupture is only into the mediastinum both pleural cavities usually contain bloody fluid and when the rupture extends into one pleural cavity the other shows bloody fluid at post mortem. In I case the pericardium contained bloody serous fluid.

The laceration in the wall of the esophagus has always been immediately above the diaphragm and longitudinal in all cases except 2. In that of Boerhaave⁵ the gullet was torn entirely across just above the diaphragm and in that of Tändler³⁹ the laceration was transverse. The left and posterior walls of the esophagus have most often given away and the right and anterior, less frequently. The tears have been from ¾ in. to 2 in. long. The walls of the esophagus near the tears have frequently shown signs of chronic inflammation or other pathology but in many cases nothing

has been found which could not be explained by the violently acute process present in the mediastinum and pleural cavity.

The origin of the emphysema appearing first in the neck above the suprasternal notch has given rise to considerable speculation. It most probably arises from air forced into the mediastinum from the stomach at the time of rupture or from the air in the pleural cavity. It is well known that violent coughing or straining with or without tracheal obstruction may be followed by subcutaneous emphysema. The pneumothorax itself may arise from air in the stomach or from air swallowed after the accident and may therefore be delayed at times for several hours.

The victims of spontaneous rupture of the esophagus have usually been men of an average of forty-two years, often alcoholics, who during the act of vomiting or retching have experienced sudden severe pain in the upper abdomen or lower chest; most frequently in the left lower chest and back. The vomiting has always taken place after a full meal or at least when the stomach was full and nearly always some blood has appeared in the vomitus. The pain has been of a severe character unrelieved by large doses of morphine. The patients assume a sitting position stooping forward, or a similar position lying on the involved side. They do not want to lie flat on their backs as in abdominal perforations. Frequently, they relate that at the onset of their pain they had a feeling as of something tearing or giving away in the lower thorax. The patients are found in considerable shock with dyspnea and cyanosis as characteristic symptoms.

If the rupture takes place into the pleural cavity there will soon be evidence of pneumothorax, displacement of the heart, diminution of the breath sounds, changes in the expansion of the lower chest and fluid dullness. These chest signs and symptoms will not be characteristic if the rupture extends into the mediastinum only and frequently not in the first few hours

when the rupture is into the pleura. Some patients complain of an increase of pain on swallowing or eructating. A peculiar symptom has been the presence of emphysema appearing first above the suprasternal notch and spreading to the chest, abdomen, and even scrotum. This symptom has been present in two-thirds of the cases reported. The patients have complained of more or less pain and soreness in the epigastrium or whole abdomen and muscle spasm has usually been present. These symptoms have led in a number of cases to a diagnosis of an intra-abdominal perforation and unnecessary surgery. The whole clinical picture is one of a serious accident to the thoracic or abdominal viscera in which profound shock and sepsis rapidly develop.

The onset of this clinical picture with vomiting followed by abdominal pain, soreness, and muscle spasm will require the ruling out of such acute abdominal conditions as ruptured peptic ulcer and acute hemorrhagic panereatitis. However, the pain referred to the lower thorax, the marked dyspnea and cyanosis should lead immediately to a careful examination of the chest. The presence of diminished breath sounds, pneumothorax, cardiac displacement, and fluid dullness will justify a paracentesis of the pleural cavity. If stomach contents are found in the aspirated fluid a diagnosis is assured provided diaphragmatic hernia can be ruled out. The x-ray is of value in proving the presence of the pneumothorax, lung collapse, and heart displacement. The diagnosis of the rupture in the esophagus by means of a barium meal, although it might be conclusive, will not be practical because of the condition of the patient. In case the esophageal rupture is into the mediastinum only, an accurate diagnosis will be difficult. The x-ray with or without a barium meal will be helpful. An examination with the esophagoscope will suffice if the patient can be controlled. The presence of emphysema in the neck will lead to at least a suspicion of esophageal rupture.

The treatment of a case of rupture of the

esophagus, if one is so fortunate as to make an early diagnosis, will depend upon whether the rupture has taken place only into the mediastinum or into the pleural cavity on one side or the other. The rupture into the mediastinum will result in an extensive cellulitis more often than an abscess because of the force with which infected stomach contents is driven into the loose cellular tissue of the mediastinum. An abscess may be diagnosed, opened and treated through an esophagoscope but the drainage of a mediastinal cellulitis in this way will be entirely inadequate. The lower posterior mediastinum has been drained for acute mediastinitis by removing the lower ribs at the costovertebral angle on the right or left side. The operation is known as posterior mediastinotomy. The serious condition of the patient, however, will make this procedure extremely hazardous and of doubtful value. When the rupture takes place into the pleural cavity, free and prompt drainage of the cavity is imperative. In such a case, if the patient survives the infection of the pleura and the accompanying mediastinal involvement, he will develop an esophageal fistula which

will probably close spontaneously. Feeding through a duodenal tube or gastrostomy will of course be required. Later, dilation of the esophagus to prevent stricture will be necessary.

American Journal of Surgery

RESUME

- 1. Rupture of the esophagus may follow vomiting.
- 2. Serious damage to the esophagus has followed the vomiting of pregnancy.
- 3. The ruptured esophagus has often been abnormal before the rupture.
- 4. Probably a normal esophagus can be ruptured by vomiting.
- 5. Rupture of the esophagus from vomiting can occur only when the stomach is full.
- 6. Abdominal pain, soreness, and muscle spasm suggest intra-abdominal pathology.
- 7. Thoracic pain, dyspnea, cyanosis, emphysema of the neck, and physical signs in the chest following vomiting should suggest esophageal rupture.
- 8. In rupture into the pleura, thoracotomy is imperative.
- 9. A case of spontaneous rupture of the esophagus following vomiting is reported.

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PERFORATION OF THE CECUM RESULTING IN INVAGINATION OF THE SMALL BOWEL INTO THE LARGE INTESTINE WITH AN ILEOCECAL INTUSSUSCEPTION WITHIN A COLIC INTUSSUSCEPTION*

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THE causes and variations in the production of intussusception are manifold. Almost all, however, can be classified and the mechanism of their production explained. The case to be presented is such that a careful survey of the literature on this subject failed to reveal one of a similar type. Its explanation must be to some extent problematical.

E. P. Female, five and one-half months old. Admitted to Harlem Hospital December 22. 1929. Died December 22, 1929.

Family History: irrelevant.

Past History: normal delivery, no previous illness, medical or surgical.

Present History: on December 16, 1929, child became ill, vomited a large amount of milk and water. Child cried loudly, fell asleep and awoke suddenly and cried again. Vomiting continued December 17 and 18, following all food intake. After December 18, child did not vomit until December 22, the day of admission to the hospital. Vomiting continued throughout the day; at first of recently ingested food, and then bile colored fluid. Bowels had not moved since December 16, 1929. Enema returns consisted of clear fluid with mucus and blood.

Physical Examination: reveals an acutely ill baby of five and one-half months.

Head: anterior fontanelle open and sunken. Eyes: deeply set with black rings around them. Pupils dilated and equal, reacting to light.

Mouth: mucus membrane and lips dry, tongue coated and brown.

Face: cold and pale. Neck: no retraction.

Chest: heart rapid and feeble.

Abdomen: no adenopathy, markedly distended, no rigidity, tenderness on palpation over left lower quadrant. No masses palpable. No visible peristalsis.

Rectal Examination: sphincter dilated, anus covered with a pinkish discharge. About 115 cm. within the sphincter a hard indurated umbilicated mass can be felt. This mass extends up within the rectum as far as the examining finger can be inserted. Around this mass can be felt the rectal mucosa.

Extremities: cold.

Clinical Pathology: urine acid, albumin 1 plus, with a few hyaline casts. Positive acetone. White blood corpuscles, 14,000. Polymorphonuclears, 81 per cent. Lymphocytes, 19 per cent.

Diagnosis: intussusception.

Operation: December 22, 1929 at 6 P.M. Right lower paramedian incision. Serous sluid found on opening the abdomen. Mass felt extending from the ileocecal region to the sigmoid. Appendix and cecum cannot be seen (Fig. 1, A and B). The mass proved to be an intussusception. After the apex of the intussusception was reduced to the middle of the transverse colon, reduction was difficult. At this time the appendix, cecum, and the ileum which was severed 10 cm. from the ileocecal valve, came into view (Fig. 1 c). Through a perforation of the cecum was seen an everted ulcerated patch of mucosa, and going through this perforation was found the ileum, which was not intussuscepted but invaginated. This was reduced by gentle traction and the oral severed end of the ileum was located. There was an escape of feces as the oral end of the ileum was delivered. Simultaneously with the reduction of the intussusception to the middle of the transverse colon, two bursting rents occurred at the antimesenteric border of the ascending and transverse colon (Fig. 1 D). The condition of the child at this time was so precarious that a rapid resection of the large bowel to the splenic flexure was performed. The distal end of the splenic flexure was invaginated with a double purse string suture. A tube was inserted

*Presented to the Clinical Society, Harlem Hospital, January 30, 1930.

into the severed oral ileum, which in turn was sutured to the lower end of the incision. Routine closure with in situ and pelvic drainage.

Pathological Report: December 29, 1929. Clinical diagnosis, intussusception; source of specimen, bowel resection.

Gross Report: the specimen consists of the cecum, ascending and transverse colon with 10 cm. of ileum. There are two fresh rents, one at the antimesenteric border of the ascending colon 8 cm. in length, the other at the antimesenteric border of the transverse colon 5 cm. in length. The distal end of the colon is crushed by a clamp. The aboral end of the ileum is gangrenous and sharply demarcated. Between the ileum and the appendix is a perforation, $2\frac{1}{2}$ cm. in diameter, the edges are everted, congested and swollen, with an exudate. On section an ulcerated patch of mucosa is seen just below and fusing with the lower border of the perforation.

Microscopical Examination: none made.

Progress Notes: temperature on admission 99° F., 100°F. before death. Pulse too rapid to count. Respirations 48. Two hundred fifty cubic centimeters saline clysis given at 3.30 P.M. Soapsuds enema given at 4 P.M., returned clear with particles of mucus, no blood. Five hundred cubic centimeters saline clysis given at 5.30. P.M., 500 c.c. saline clysis given at 7 P.M. Patient died at 8.55 P.M.

Comment: the exact sequence of the events which brought about this mechanism of obstruction must be one of conjecture. A possible explanation of the mechanism is given.

An early perforation of the cecum occurred. This assumption is based on the appearance of the perforation with its everted mucosa at the lower border. The area involved was hemorrhagic and covered with a fibrinous exudate. How the perforation was produced is difficult to state.

The ileum became invaginated through this perforation into the ascending and transverse colon. The blood supply to the involved ileum was not impaired except at a point 10 cm. from the ileocecal valve. Here it was severed, the result of a circular area of gangrene.

The ileum in this position in all probability acted as a tumor and caused an ileocecal intussusception. The primary ileocecal intus-

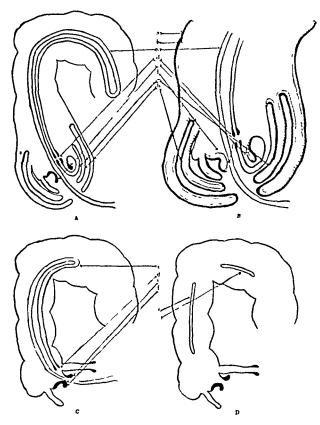


Fig. 1 A. Pathology found at operation. B. Enlargement of A., focusing upon the ileocecal region and ascending colon. a. heavy black line indicates serosa. b. cellular line indicates mucosa. c. invaginated ileum. d. areas of severed gangrenous ileum within the cecum. c. edges of perforation in cecum. f. everted mucosa of cecum, presenting itself at lower border of perforation. g. ileocecal intussusception. h. colic intussusception c. Pathology found after apex of intussusception was reduced to middle of transverse colon. c. invaginated ileum. d. areas of severed gangrenous ileum. c. edges of perforation in cecum. f. everted mucosa of cecum, presenting itself at lower border of perforation. d. Specimen removed at operation. i. rent in the ascending colon. j. rent in transverse colon.

susception could not continue as such, as it was prevented by the invaginated ileum within the ascending colon. Peristalsis still being present, the invaginated small intestine and ileocecal intussusception continued as a single apex resulting in a true colic intussusception.

L-SHAPED RUBBER TUBE FOR DRAINING THE BILIARY TRACT*

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In many operations upon the biliary tract some form of drainage is indispensable. Either the ordinary rubber catheter brought into use by Mayo Robson¹ or the rubber T-tube whose use was advised by Deaver² of America and by Kehr³ of Germany is usually employed in draining the common and hepatic bile ducts.

When a catheter is used a soft, pliable one should be chosen. It can have numerous lateral eyes to facilitate the internal and external drainage of bile. The fenestrated end of the catheter is placed in the bile duct pointing towards the liver. The bell end of the catheter passes through the incision in the duct and the incision in the abdominal wall. The chief disadvantages in the use of the catheter are that it cannot be fixed securely in the bile duct for prolonged drainage, and that scar formation and stricture may result from damage done to the duct wall by the anchorage sutures. As the catheter cannot be bent at at a right angle without obliterating its own lumen, it must lie in a long curve that allows it to slip out of the bile duct. Leakage of bile round the catheter sometimes occurs when after a few days the tube becomes loosened. Strong sutures must be used to fasten the catheter in place. There is considerable tugging and pulling at these sutures which may result in tearing the duct walls. In the healing which follows such as injury scar tissue may be formed, and contraction of this scar tissue may lead to a stricture of the bile duct.

The rubber T-tube ensures free internal drainage of bile and prevents back pressure in the liver by allowing external drainage if the bile cannot flow through to the duodenum. The T-tube remains in position when it is placed in the lumen of a bile duct, and the duct wall can be closely sutured about it. There are, however, two important disadvantages in

the use of the T-tube; first, that its removal frequently causes damage by tearing the wall of the bile duct; second, that when an attempt is being made to pull the T-tube out of the wound the stem may break off leaving the transverse portion in the duct. Stricture of a bile duct has followed the use of a r-tube when the duct wall has been torn during the removal of the tube. As the portion of the T-tube projecting through the abdominal wall is pulled, tension is exerted through the stem of the tube on its transverse portion which is pulled upwards at its center against the opening in the bile duct. The force necessary to draw the double arms of the T-tube out of the drainage opening could easily dilate the opening sufficiently to cause the soft and friable walls of a healing duct to collapse, or the force might be great enough to split the duct transversely for more than half of its circumference. The tearing and subsequent healing of the duct wall would result in a scar which might later contract and cause a partial or complete occlusion of the duct's lumen. Kehr,3 who frequently used the r-tube in his operations on the biliary tract, tried to prevent the tearing of the duct walls by cutting off one end of the transverse portion to 1/2 cm. Kehr³ also discovered in his use of the T-tube that its early withdrawal tore out the sutures which had been placed in the choledochotomy wound. McArthur4 and others have reported that stricture sometimes occurs following the tearing of the duct wall during the removal of a T-tube. It should be borne in mind that any form of bileduct drainage may predispose to stenosis, and that infection in the fistulous tract may also cause necrosis and sloughing of the duct wall with subsequent stenosis. Therefore the catheter or T-tube cannot be blamed for every case of stricture which occurs following their use. Not only may

the removal of a T-tube injure a duct wall, but when the stem of the tube is being pulled it may break off and leave the transverse portion in the bileduct. When this happens it becomes necessary to operate upon the patient in order to remove the transverse portion of the T-tube from the duct. This accident happened to Kehr³ in one of his early cases and it has also happened to others (Fig. 1).

In order to overcome the disadvantages of the ordinary rubber catheter and the rubber T-tube I have devised an L-shaped rubber tube for draining the biliary tract. The L-shaped catheter provides a means of both internal and external drainage of bile, it can be securely fastened in a bile duct for temporary or prolonged drainage, and it can be easily removed at any desired time without injuring the duct wall. The L-shaped tube is a catheter with 2 in. of its end bent almost at a right angle. This bent portion of the tube has six eyes to facilitate drainage, one in the tip, one in the elbow, and four placed laterally. The L-shaped catheter is made in sizes 16 and 18f., which we have found best suited for drainage. When the L-shaped catheter is to be used to drain a bile duct the short, bent portion of the tube, which can be cut off to any desired length, is inserted into the duct through a choledochotomy wound or through a small slit made in the duct wall above or below a reconstruction. The tip of the catheter can therefore point either downwards towards the duodenum or upwards towards the liver. The fenestrated portion of the tube which lies within the duct prevents swelling or edema from occluding or constricting the lumen of the duct, and in the case of a reconstruction supports the line of suture. This fenestrated portion of the tube also supplies a means of through-and-through drainage of bile. Should there be a temporary obstruction which prevents bile from flowing into the duodenum it can drain externally through the long portion of the tube which passes through the slit in the duct wall and out of the abdominal wound.

When the L-shaped catheter has been placed in position in the bile duct the opening of the duct is tightened about it

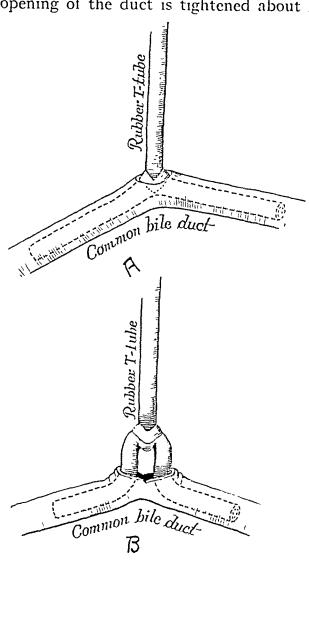




Fig. 1. Manner in which common bile duct might be damaged in withdrawing a rubber T-tube. A. Showing opening in common bile duct being dilated and duct being pulled upwards when tension is made on stem of T-tube to withdraw it. B. Showing relative amount of dilatation necessary to pull two arms of T-tube through drainage opening. c. Showing common bile duct torn transversely by force exerted in order to bring both arms of T-tube through opening in duct

by suture. After the suture is knotted it is wound about the catheter to hold the tube securely in the duct. The bell, or funnel, end of the catheter is brought out of the upper end of the abdominal wound. To hold the catheter in the

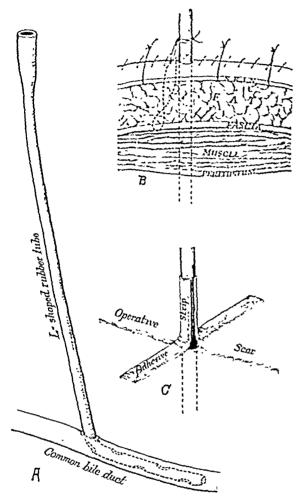


Fig. 2. L-shaped rubber catheter for draining common bile duct. A. Showing L-shaped rubber catheter in common bile duct. It will be noted that the eye in the elbow and the one in the tip of the L-shaped catheter provide a means of continuous flow of bile when there is no obstruction in the duct. It will also be noted that the lateral eyes in the L-shaped catheter will facilitate external drainage if there be an obstruction. n. Method by which L-shaped catheter can be held in place with silkworm suture during first two weeks after operation. c. Method by which L-shaped catheter can be held in place with adhesive straps after wound has healed sufficiently to remove sutures.

abdominal wall and to prevent its being pulled out after the operation, a silkworm suture may be fastened into the skin which can include the external sheath of the rectus muscle. The suture ends should be wound about the catheter and tied. To hold the catheter in position after the wound was healed, two strips of adhesive plaster may be placed along opposite sides of the tube and extended

outwards on the skin. It has been found that better results follow when drainage is maintained for a considerable time. The drainage tube should be left in place for several weeks or several months depending upon the conditions which were found at operation and the character of the bile flowing through the tube during convalescence. Before the drain is removed it should be clamped off for two or three days to make certain that bile is flowing into the duodenum. The L-shaped drainage tube can be removed by traction being made on that portion which projects out of the abdominal wound. The tube will then slip out easily without tearing or dilating the opening in the duct. The small drainage opening through which the tube passed usually heals quickly (Fig. 2).

ADVANTAGES OF THE TUBE

1. It can be introduced easily into the common or hepatic bile duct.

2. It can be placed with its tip towards either the liver or the head of the pancreas.

3. It has an opening at the tip and one at the elbow, making a communicating channel from the upper portion of the bile duct to the lower for the continuous passage of bile.

4. It has four lateral eyes to ensure drainage in case the opening in either end becomes plugged.

5. The bell, or funnel, end provides a means of external drainage if an obstructing mass or edema prevents internal drainage.

6. Drainage can be maintained by holding the catheter in place with a silkworm suture during the first ten days or two weeks, and later with strips of adhesive.

7. The catheter can be withdrawn easily without damaging the duct wall.

8. There is no danger of breaking off a portion of the tube during its removal.

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GALL-BLADDER DISEASE*

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der, with or without the presence of stones, is of fairly frequent occurrence. Its recognition is not difficult and the importance of proper treatment generally appreciated. A series of 65 cases treated surgically at the Orange Memorial Hospital, during the past three years, has demonstrated some interesting conditions and taught some valuable lessons. The result of this experience and the observations made, form the basis for this discussion of the subject.

The diagnosis of gall-bladder disease is usually apparent from a fairly consistent clinical history. The familiar syndrome of, "indigestion" flatulency, belching of gas, epigastric distress; accompanied by recurrent attacks of pain in the upper right quadrant of the abdomen, radiating beneath the scapula, indicates gall-bladder pathology. The discomfort varies in degree from merely a sense of fullness, to severe colicky seizures, requiring an opiate for relief. There may be nausea and vomiting and an attack may be followed by jaundice. The usual type of individual is one who is inclined to an excess of fat, about forty to fifty years of age, women being more frequently attacked than men, the average being 3 to 1. Deaver aptly expresses it, "fair, fat and forty." There were 60 women and 5 men in our group, the average age being forty-six, the oldest seventy and the youngest nineteen.

In addition to the given symptoms, the greatest aid to correct diagnosis is chole-cystography. The information obtained from an x-ray study, after the method developed by Graham, which consists in the employment of the dye, sodium tetra-iodophenolphthalein, either orally or intravenously, is of great value. The concentration of this dye within the gall bladder,

delineates its contour, demonstrates irregularities and shadows, and the rapidity with which the gall bladder empties after a fat meal. The failure of the dye to enter the organ indicates an obstruction, from some cause, either in ducts or ampulla; all of these are factors upon which deductions as to the condition of the gall bladder, may be made.

In a recent article, Kirklin of the Mayo Clinic, reports that correct diagnosis may be made in approximately 90 per cent of cases. He also states in a series of 287 cases, that the oral method proved as satisfactory as the intravenous. Most of our recent cases have been radiographed and the roentgenologist's report substantiated. Some of the patients, with typical clinical histories, have been operated upon, without previous x-ray study.

In an interesting paper recently read before this society, Dr. Reitter discussed this aspect and he reported a high percentage of positive findings; of 70 cases coming to operation, the diagnosis was confirmed in all but 3. The present method of administering the dye has been satisfactory in our experience. Cholecystography has been the means of a better knowledge of the physiology of the gall bladder. It has been shown to be the storehouse for the reserve supply of bile, a place for its concentration and its regulated supply. The gall bladder is full during fasting and empties its contents during active digestion. In the absence of the gall bladder, some of its function is assumed by the ducts and it has been well established that an individual may enjoy good health in the absence of the organ. The experiments of Rous, McMaster and Aschoff² indicate that the

¹ Kirklin. Coll. Pap., Mayo Clinic, 1929, p. 136. ² Rous and MacMaster, The concentrating activity of the gall bladder. J. Exper. Med., 33: 731, 1921.

^{*} Read before The Orange Mountain Medical Society, December 19, 1930.

chief function is that of a regulator of bile

supply.

The study of the blood is of value in the cases of acute gall-bladder infections, just as it is in infections elsewhere; a leucocytosis indicates the relative degree of infection, the development of suppuration, etc. The estimation of bile pigment content of blood serum is a help in determining an obstructive jaundice. The indirect quantitative method of van den Bergh is probably the most reliable. This depends upon the presence of bilirubin in the blood: high concentration would indicate an obstructive jaundice. The icterus index test when showing a stationary or rising curve, would indicate the existence of an obstructive jaundice. The van den Bergh test was used in some of our cases, to determine whether the jaundice present was due to obstruction or to a hematogenous cause.

The causative factors of gall-bladder disease are somewhat uncertain, but the factor of infection plays the chief rôle. The organ may harbor the ordinary bacteria of infection in its walls: stasis with poor drainage; the presence of stones, which irritate the mucosa of the lining, just as any foreign body furnishes ideal conditions for both acute and chronic inflammation. The existence of pregnancy predisposes to disease of the biliary tract, because of the great increase of cholesterol at this time, and the disturbance of cholesterol metabolism is an important etiological factor, as has been emphasized by Whipple.1

The excessive ingestion of fats, such as olive oil, may have some bearing on the frequency of its occurrence in Italian women. The existence of a chronic appendicitis, in conjunction with cholecystitis, is a frequently observed occurrence. The factors of this relationship are not definite. Graham states² in its consideration, that the most plausible connection between the

two organs is by the lymphatics, rather than by the blood stream, through the liver. In our series, evidence of the existence of definite disease of the appendix was demonstrated in 37 cases, or 56.9 per cent. We have made it a rule to remove the appendix in all cases where feasible, and in which there were no contraindications. 2 cases, small fibroid, string-like atrophied appendices were left in situ. In one man his appendix could not be demonstrated. In 5 cases, because of the serious condition of the patient, the appendix was not examined. In Judd's series at the Mayo Clinic, chronic appendicitis was found in 31 per cent. The appendix had been previously removed in 19 cases, or 20 per cent. It has not been possible to determine whether an examination of the gall bladder was made in all of these cases at the time of original operation, but the frequency of this occurrence is an argument for careful examination of the gall. bladder in all cases.

The treatment of gall-bladder disease by biliary drainage after stimulation with magnesium sulphate, has been extensively employed. Vincent Lyon developed a technique which was claimed to be effective and which is still employed by some internists. It undoubtedly has been effective in some of the cases of chronic cholecystitis with stasis and without calculi. Four of our cases were so treated, without relief. It is our opinion that chronic cholecystitis and colelithiasis are surgical conditions. Many individuals may have gallstones without active symptoms. In operating upon patients for other conditions, their presence may be discovered. Autopsies reveal the presence of stones in subjects who gave no history of such disease. Nevertheless, the presence of stones in a gall bladder or ducts, offers a definite menace to an individual's well being and sooner or later, clinical symptoms become apparent. The typical manifestation of presence of calculi, is the occurrence of colic, which happens more often when small calculi are being forced

¹ Whipple, A. O. Pathogenesis of lesions of biliary tract. Nelson's Loose Leaf Surgery, page 467.

Graham, Cole and Copher. Disease of gall bladder and bile ducts, page 11-.

into the ampulla or ducts. Stones vary in size from a millet seed to an egg; may be single or the entire gall bladder be filled. The composition varies from the simple cholesterol calculus to those containing a large proportion of calcium, which gives a more definite shadow in the x-ray films. In our 65 cases, calculi were found in the gall bladder alone, in 33 instances, 51 per cent; in the gall bladder and cystic duct in 7 cases; in the common duct in 5 cases, 9.2 per cent; in the hepatic duct in I case, 1.5 per cent. There were evidences of chronic infection of the gall bladder with thickening, discoloration of the walls, sections showing pathological changes in 31 cases, 47.6 per cent, in which there were no calculi. In one group comprising 14 cases, there were firm, well organized bands of adhesions between the gall bladder and the duodenum, stomach and liver. These cases were all attended by symptoms suggesting the presence of calculi and yet none were found. One case showed an hour-glass contraction at the middle of the gall bladder. In one there was a broad band of adhesions from the fundus of the gall bladder, encircling the pylorus and distorting the cap. Some of these adhesions may be congenital bands, such as are known to occur elsewhere within the peritoneal cavity, a fact which has been emphasized by Dr. Alfred Taylor of New York. Radical treatment of these cases is followed by a complete relief of symptoms.

Where the cystic duct is obstructed by calculi, the gall bladder becomes functionless and in 3 cases, Mrs. T. No. 41, and Mrs. F. No. 59, and Mrs. H. No. 57, hydrops developed, the organ distending to four times the normal size. Usually the stones can be gently milked back into the gall bladder from the cystic duct; but where impacted, the duct should be incised and the stones removed. The duct should be thoroughly exposed and clamped well above its entrance into the common duct, for it is in this procedure that many of the accidents occur, which are followed by

scar tissue deformity and obstruction of the common duct. In 1 case, Mr. M., a patient of Dr. Hunt's, a cholesterol stone, the size of a marble, had become impacted in the cystic duct and ulcerated partly through the wall; there were also calculi in the gall bladder in this case, which were not demonstrated by the x-ray. An uneventful recovery and relief of symptoms followed his operation.

Prior to the time of the present series was the single case of hepatic duct obstruction which was instructive. The history of this patient was as follows:

Case I. Mrs. M. aged forty-one, had frequent attacks of gallstone colic from 1916 until the date of her first operation, January 24, 1921, at which time a large number of gallstones were removed and the gall bladder drained, the appendix being removed at the same time. She remained well for eight months, when epigastric distress and flatulency returned. One year after the operation, she had an attack of colic similar to original seizure; such attacks occurred at varying intervals until January 19, 1924, when she was reoperated upon, for suspected gallstones. None were found but the gall bladder was buried in adhesions and the cystic duct sharply kinked. The gall bladder was removed. In separating adhesions, a small duct, apparently a branch of the hepatic, was injured with a leakage of bile following; drainage was established and except for the development of a cystitis, she made an uneventful recovery, remaining well until July 7, 1925, one and a half years after the second operation. At this time she had an attack of jaundice lasting two weeks; this was followed by intermittent attacks until they became persistent in November. Common duct obstruction was suspected from a calculus which had not been discovered. On December 11, 1925, the abdomen was re-opened, common duct found patent without stones; a stricture of hepatic duct was found 11/2 in. from entrance into liver; the duct was incised and two firm masses of inspissated bile removed, a free flow of bile from the upper end of duct obtained; a small rubber tubing, 2 in. long, was introduced into duct, after surrounding adhesions were freed, the tube having a strong linen thread attached, which was drawn out through the wound. The duct was sutured and the area

covered with omentum, drainage tube inserted and abdomen closed. She made an uneventful recovery, the tube was removed through the abdominal wound on the twenty-sixth day. There was a small amount of bile leakage for two days. She left the hospital on the thirtyeighth day and has been in excellent health since.

There have been 5 cases of stone in the common duct in our series. Calculi in the common duct may be overlooked and it is important to search carefully for their presence. This should be done by free exposure of the duct, to give good visualization and careful palpation. If the history be suggestive, and there be any doubt, the duct should be explored by probe or small rubber catheter. If the stone be small, it may be delivered through the cystic duct, or if impacted, through an incision directly over it. One of our cases, No. 2, Mrs. H., had a calculus in the ampulla of Vater. It was necessary to mobilize the duodenum by incising the parietal peritoneum, rotating inward, thus exposing the common duct down to its entrance into the duodenum. In cases where symptoms persist following cholecystectomy, the possibility of a common duct stone should be considered. One of our cases, Mrs. S., who was operated upon on October 8, 1929, stones being found in the gall bladder and cystic duct, has had a recurrence of pain; there has been no jaundice or severe pain and careful x-ray study reveals nothing, but she may have a small common duct calculus.

Some cases of common duct obstruction from stricture, are those in which some form of difficulty has been encountered at the original operation; for example, in the attempt to control hemorrhage, the hepatic or common duct may be grasped by forceps and a contraction occur following the application of a ligature. The cutting of the cystic duct too close to the common may be followed by a contraction at that point. There were 3 cases of common duct obstruction from stricture. One interesting

case of common duct obstruction was reported at the hospital clinical meeting.

Case II. This was an Italian woman fiftyone years of age, on whom a cholecystectomy was done December 1, 1928. Her abdomen was closed without drainage and had to be reopened on the seventh day for leakage of bile from remnant of cystic duct. She was discharged as cured January 6, 1929, and remained well until November, 1929, when she became jaundiced, which condition steadily increased until January 28, 1930, when at operation a stricture of the common duct at point of entrance of cystic duct was found. A T tube was introduced, the jaundice clearing promptly and she was discharged as improved on February 22 with tube in situ. The tube remained, with the patient in good health, until May 12, 1930, nearly four months, when it was removed. In July, two months after its removal, intermittent attacks of jaundice began to occur, becoming deep and persistent during the first part of September. On Sept. 27, 1930, further exploration revealed a contraction and constriction of the lower end of the duct, from scar tissue, the lumen being practically obliterated at the point corresponding to the portion of the lower limb of the T tube. The upper part of the duct being patent, it was dissected free and sutured into the wall of the duodenum, around a T tube, one end of which projected into the lumen of the duodenum and the other short end upward into the duct, the whole being then surrounded by omentum, a tight anastomosis having been made. The jaundice disappearing entirely in two weeks, the patient left the hospital with the tube in situ, on October 29, one month and two days after operation. She has remained well, with normal bile in stools, since. This tube may be removed and replaced by an indwelling plain tube, which can be discharged through the intestine later. However, this patient was in good health during the four months in which the T tube was within the duct, from January to May; partial obstruction occurred from contraction of the scar tissue at the point of exit of T tube, within two months after its removal and complete obstruction after four months. Her normal supply of bile has now been restored to the duodenum, by means of the anastomosis reinforced by the tube dwelling within this anastomosis.

My plan has been to leave the tube in situ for an indefinite time, so long as the patient remains well and then remove it when a well organized fistulous tract may have time to form. A very comprehensive article on the sequelae of the gall bladder infections by Dr. Deaver, in the Journal of the American Medical Association, November 29, 1930, cites some very interesting observations, one of which will be quoted.

Just one word about T tube drainage. The mucous membranes are very tolerant to rubber. The retention catheter, for example. I had one patient, who wore a retention catheter for fourteen years and he remained perfectly well. If the urethra is tolerant to a rubber tube, why not the common duct? Some of my patients wear the T tube indefinitely with equal tolerance. One woman wore one for *four* years. Then I had great trouble getting her to let me take it out, because three operations done previously were followed by recurrence.

This gives me great comfort in my management of the case in question.

Case III. The third case of common duct obstruction was a woman, Mrs. C., operated on May 3, 1930. Her gall bladder had been removed in 1923 and her health had remained good for four years or until 1927, when she had her first attack of jaundice. The periods of jaundice became more frequent and of longer duration and on her admittance she was deeply jaundiced. At operation the stump of cystic duct was found adherent to under surface of liver. The T tube being left in for two weeks, the jaundice disappeared promptly and she made a good recovery and has remained well since.

Case IV. One other case, Mrs. F., No. 18, operated upon May 22, 1928, was closed without drainage and had to be re-opened on the sixth day for biliary leakage. The patient developed a pleurisy with effusion and was in the hospital for twenty-six days. She made a good recovery and is today in good health.

Eighteen cases were closed without drainage and of these, 2 cases had to be re-opened. This was due to some error in technique on our part. Possibly the ligature on the cystic duct slipped, but such an accident should not occur; if it should, a drain would preclude serious complica-

tions. In the Annals of Surgery, September, 1930, Saunders reports the end-results in 500 cases of cholecystectomy. In 172 cases or 34.4 per cent, the abdomen was closed without drainage. It was not necessary to re-open the abdomen in a single case, nor had there been evidence of leakage of bile into the peritoneal cavity. Richter of Chicago was one of the first to advocate closure in these cases. Many cases can undoubtedly be closed with safety, but the patient's best interest is assured by the introduction of a small rubber catheter drain, which can safely be removed on the fifth day, the wound being well healed by the twelfth or fourteenth day. This is the routine practiced at the present time.

We believe that cholecystectomy should be the procedure of election. A gallbladder which has been drained and left in situ, may be the seat of further calculus formation, does give symptoms from adhesions and increases the likelihood of further surgical complications. There are certain conditions, such as an acute gangrenous gall bladder, empyema of the gall bladder with jaundice and patients who are very poor surgical risks, in whom cholecytostomy should be done, because as in other acute emergency operations, within the abdominal cavity, our aim should be to afford relief to a serious condition, with the least possible risk to the patient. Operations upon the gall bladder and ducts are serious and should be approached with proper conception of what is to be done and due appreciation of the technique of its performance. Our method has been to remove the gall bladder from below upward, first exposing the ducts thoroughly; ligating the cystic artery separately, thus enabling the cystic duct to be put on a stretch and carefully ligated; the dissection being carried upward leaving the peritoneal margins on either side of the sulcus of the liver and closing all raw surfaces. Subserous dissections from above downward is a good procedure, but does not afford as good as an emosure of the cystic artery.

The choice of anesthesia is of importance.

In the majority of cases, a spinal anesthesia is the method of election. It gives a far better relaxation, with wider exposure, a reduced respiratory excursion of the diaphragm, less distention of the intestines, requiring fewer abdominal packs. In this series there were 31 spinals, 32 generals, 2 avertin anesthesia. Avertin alone or with a supplementary of gas oxygen, is satisfactory; but in our experience, spinal anesthesia greatly reduces the difficulties in gall-bladder surgery. Sodium amytol was used in conjunction with spinal anesthesia in 6 cases. It affords the great advantage of having the patient anesthetized in the room, avoiding any of the impressions or memories of the trip to the operating room. It has the added advantage of a longer postoperative sleep.

Cass v. The case of Mrs. J., aged sixtyseven, one of the first of our cases to be done under a spinal, was gratifying because of the unusual history. In 1919, her appendix was removed by a New York surgeon; in the course of his examination, a gall bladder with many stones was discovered. Because of her poor behavior under the anesthesia, her gall bladder was simply drained. In 1925, she was re-operated for suspected stones by a Chicago surgeon. His version of the operation is as follows: "adhesions from the fundus of the gall bladder to duodenum, producing a Harris kink, were found and freed, as were adhesions from the liver to the diaphragm, the thickness of a lead pencil. There were no stones in the cystic, hepatic or common ducts. It was my intention to remove the gall bladder, but tension on gall bladder, stomach or liver, produced a respiratory paralysis; the patient stopped breathing for over a minute: this did not occur only once, but five times on the table, the patient stopped breathing; consequently we found it absolutely impossible to remove the gall bladder." Under spinal anesthesia, a gall bladder buried in adhesions was easily removed and this woman, who was a chronic invalid, has been entirely well for the past three years.

The average length of time in the hospital was 20.8 days, the longest being sixty-four days in a patient, a nurse, who was a chronic invalid, who developed a

phlebitis and who was more happy and comfortable in the hospital than in her apartment. The shortest length of stay was eleven days.

In the treatment of acute cholecystitis, unless there is evidence of rapidly spreading and severe gall-bladder infection, conservative treatment is indicated. The acutely inflamed gall bladder will localize the infection more readily than an acute appendix. If the condition shows evidence of spreading or increasing in severity, as shown by elevation of temperature and blood count, surgery should be resorted to at once and this is one of the conditions in which drainage rather than removal of gall bladder may have to be resorted to. However, if the condition be confined to the gall bladder and there be not excessive edema of the gastrohepatic omentum, in the region of the ampulla and ducts, cholecystectomy should be the method of choice. Each individual case should be decided upon the basis of the condition found, the guiding attitude always being the employment of the procedure, which gives the patient the best assurance of a permanent relief.

Of the four deaths in this series, one, Mr. D. No. 8, was a case of perforated gangrenous gall bladder. His condition was grave throughout and he died of a terminal pneumonia. Mrs. B. No. 38, developed a lobar pneumonia on the tenth day, the interval being uneventful; her death occurred thirty-seven days later or forty-seven days after operation. The general and cardiac condition of this patient was poor; the possibility of empyema was suspected and she was seen by a number of physicians. Autopsy revealed an unresolved lobar pneumonia, with small serous pleural effusion. The site of the gall bladder removal and peritoneal cavity and liver was normal. Mrs. K. aged sixtyone, No. 63 was a case of common duct stones, who died in twenty-four hours of surgical shock. She was in poor condition at the time of operation. Mrs. M. No. 21, aged forty-one, three months pregnant,

had a perforated gangrenous gall bladder with general peritonitis. She died on the ninth day from general sepsis paralytic ileus, and one other case, Mr. D. No. 52, was a case of partial intestinal obstruction from a carcinoma of the sigmoid. This man had an acute gangrenous gall bladder with calculi and was critically ill. His gall bladder was in such a condition that it was deemed safer to remove it than to drain it. When the gall bladder was removed, the existence of a neoplasm of the colon with obstruction was not known. This was discovered in completing the examination of the intestinal tract. A colostomy was performed. He died on the tenth day from paralytic ileus.

A morality of 6 per cent is far too high for cholecystectomy. There have been no deaths in the uncomplicated chronic cholecystitis and cholelithiases cases. Our other patients have all been followed up and are in good health.

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SUMMARY AND CONCLUSION

First: Many cases of persistent, so-called intestinal indigestion, are due to chronic cholecystitis.

Second: Cholecystectomy is the operation of choice for acute and chronic cholecystis and for gallstones. Due importance should be given to the proper technical performance and possible postoperative complications.

Third: When the operation is properly performed the mortality in uncomplicated cases should be low.

Fourth: Proper medical supervision and dietary control should be part of the postoperative treatment.

Fifth: Careful search of the common duct for calculi may prevent some of the failures.



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*Continued from p. 458.

CANCER OF THE BREAST IN THE MALE*

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ANCER of the breast in the male is rare and of all the cases of breast cancer in the Radiation Department

factor is entirely irrelevant as a cause in producing carcinoma in the male breast. Marked change in function with rapid



Fig. 1. Case iv. Healed scar and good movement of the arm.

of Bellevue Hospital treated during the past six years, only 3 per cent were in the male breast.

Although the cause of cancer still remains unknown, irritation has been considered a most important predisposing factor. If this factor can be considered in the production of carcinoma of the female breast where nursing and regular periodic hormonic stimulation takes place, such a



Fig. 2. Case 1. Marked edema of the right arm.

proliferation and regression during pregnancy, often repeated, and atrophic changes following the menopause may offer some explanation for the more frequent occurrence of carcinoma in the female breast.

Until puberty the male and female breast develop alike and are embryologically of the same origin. After puberty the female breast undergoes a marked change along with the development of other sex characteristics, while the male breast remains quiescent.

Cases of Paget's disease of the male nipple have been described by several authors. Forrest in 1880 made the first clinical report of Paget's disease in the nipple and areola associated with carcinoma of the breast with lymphatic metastases in a male. Williams in a series of 2422 breast neoplasms found 25 in men

* From the Radiation Therapy Service, Bellevue Hospital, Division of Cancer. Dr. Ira I. Kaplan, Director. Submitted for publication January 28, 1931.

TABLE I

Case	Age	Nation- ality	Duration	History of Injury	Breast Involved	Glandular Involvement	Operation	Family History	Pathological Diagnosis	Remarks
1	64	Hebrew	to years	None	Right	Axilla and supraclay-	Radical 1017	Negative	Scirrhous	Developed edema of right arm 7 years post-operatively. Died in 1926.
11	65	Christian	8 years	None	Left	Right and left avillas	Simple mas- tectomy, 1924.	Negative	Scirrhous	Died from pneumo- nia March, 1930.
111	4-	Hebrew	1 year	None	Right	Right axilla	Radical 1926.	Negative	Adenocar- cinoma	Died from pleurisy with effusion 1927.
IV	43	Christian	3 years	None	Left	Left axilla	Radical April 1928, March 1929.	Negative		Living and well. Reports to the clinic for periodic examination and observation regularly.
v	50	Hebrew	'i year	None	Right	Right axilla	Radical March and July 1930.	Negative	Adenocar- cinoma	Living and well. Reports to the clinic for examinations regularly.
Vi	35	Christian	6 months	None	Right	Right axilla	Simple excision. June 1930.	Negative	Adenocar- cinoma	Reports to the clinic regularly. Complains of pain in the back and spine. Roentgen examination shows no evidence of metastasis in spine or pelvis.

of which but 16 proved to be carcinoma. Elbogen in 1908, observed a typical clinical case in a man forty-eight years old with a tumor in one breast and metastatic nodules under the skin of the opposite breast and the corresponding axilla and where about seven months after radical amputation had been performed enlarged lymph nodes appeared in the supraclavicular fossa associated with pulmonary symptoms and a marked degree of debility. The patient died shortly afterwards and the histological picture of the tumor removed at operation was that of an adenocarcinoma of the breast, with the so-called Paget's cells in the epidermis.

Jonas in 1910 reported a case in a male patient in whom the nipples and areolae of both breasts were involved, and histological studies showed carcinoma invading both breasts. Sekiguchi in 1917 referred to a case in a man sixty-seven years of age with ulcerated Paget's disease involving the nipples and areola. Warfield in his series of 307 cases of carcinoma of the breast found 3 in males. Judd and Morse of the Mayo Clinic report a series of 1757 cases of which 17 were in male patients.

The time of occurrence of the tumor in the breast of the male and female has been variously reported. In males the disease occurs a few years later than in the female and Blodgett reported the occurrence of carcinoma of the breast in a boy aged twelve, and Bryan reported one at the age of fourteen years and eight months.

The oldest in our series was sixty-five and the youngest thirty-five years. From the racial standpoint 3 were Jewish. The known duration of the tumor before operation is variously stated as from one to three years. In our series of 207 cases of breast carcinomas 6 were male and 201 were female. The average duration in the 6 male cases was six years.

The symptoms exhibited were pain, retraction of the nipple and ulceration, and the extent of these varied with the type, situation and extent of the carcinoma just as in carcinoma situated elsewhere in the body. All 6 cases had glandular involvement.

In 4 of the 6 cases here reported a radical operation was performed. In 2 cases only local excision of the tumor was done. Deep x-ray therapy was given post-

operatively in all cases. Three patients are living and report to the clinic regularly for periodic examinations.

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Results: Three patients are living and three are dead. The average length of life after operation was six years. The three living patients report regularly to the clinic for periodical examinations.

In our opinion the x-ray therapy administered following operation hindered the further growth of the disease and helped prolong the life of the three living patients. From our observation in these cases, we believe it is equally advisable to irradiate carcinoma of the breast in the male, as it is in the female.

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STONES IN THE BILIARY DUCTS*

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ALLSTONES usually form in the gall bladder but they may form primarily in the ducts. Hydrops of the gall bladder usually means a stone blocking the cystic duct or stricture resulting from a stone which has been there and passed on out or fallen back.

Etiology: A stone has a nucleus which may have been bacteria such as the colon or typhoid bacillus or the pus organisms; it may have been a clot, epithelium, or crystals; it may have been a cast of a duct; or it may have been the so-called catarrh of the ducts with mucus formation.

Cholesterosis or lithogenous catarrh or gallstone diathesis is thought to be of etiological importance. About 70 to 80 per cent of a stone is cholesterin; the rest is organic matter and lime salts. Another factor to be considered is obstruction to free drainage. Cholesterosis is usually a middle-life condition although stones may form at any age. It is much more frequent in women; possibly pregnancy has some bearing. Most patients are over forty years of age. A man's liver is larger and may have protective function against infections, etc.

Catarrhal affections predispose to stones by causing the infection and thereby the stagnation of bile. Large eaters are often affected. Those passed middle life who do not exercise are apt to suffer.

Anatomy: The gall bladder normally is about 2½ to 4 in. long and about 1 in. in diameter. The cystic duct is 1 to 1½ in. long and less than ¼ in. in diameter. The hepatic duct is about 1 in. long and ¼ in. in width. The common duct is about 3 in. long and ¼ in. or slightly more in width. About half of the duct is above the duodenum and half behind it. A short transverse vein crosses the common duct in the lower portion of the supraduodenal part.

Pathology: Coplin,⁵ in speaking of chole-lithiasis says:

Their most common location is in the gall bladder; they occur in the ducts in the following order of frequency: cystic duct; cystic and common ducts; common duct; cystic, common and hepatic; intra-hepatic ducts. Beer doubts whether there are over 150 cases of intra-hepatic cholelithiasis on record.

Jaundice means obstruction. In 80 per cent of cases of stone in the common duct the gall bladder is contracted. Loss of body weight is due to infection, pain, restricted diet, loss of sleep, etc. When stones form from some of these causes they affect the ducts and with infection of the ducts symptoms more or less characteristic are produced.

The right hepatic duct is more often involved than the left, and the common duct is more often involved than either one or than the common hepatic.

Poor drainage is produced by infection and the latter in turn may be causative of the former.

A diseased gall bladder may be any size within the abdomen. The common duct may dilate to cystic proportions and the short transverse vein on the lower part may be enormously enlarged and deceptive.

Examination of the stool after a subsided colic may be of value in finding the stone if passed.

The number and shape and type of stones vary according to time, duration, infection, general condition and location of stones.

Stones are frequently found post mortem. Stones are apt to form in the hepatic ducts if stones are present in the common duct and the latter is causing obstruction and its accompaniment, infection. Da-Costa¹ in quoting Robson says the common duct is involved in 1 out of 5 or 6 cases of

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gallstone disease. Stone may lead to catarrhal or suppurative affections. It may lead to bowel ulceration and obstruction.

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Symptoms: The symptoms vary according to location and according to whether the stone is accompanied by infection. A stone in transit gives pain. It may lodge. Involvement of neighboring organs may modify or add to the symptoms.

Symptoms occur only when a stone is in transit, when infection occurs or when deficient drainage occurs.

There is usually a past history of indigestion with constipation, flatulence, epigastric distress or pain, tenderness, maybe vomiting, and inability to eat certain foods.

When the stone begins to move pain is violent. It starts suddenly and is apt to end suddenly. If a stone in the ducts come from the gall bladder there will be a history of previous colic with or without jaundice.

The pain may cease gradually in the case of duct stone. Jaundice usually follows within from one to two days, but may be slight or absent even in common duct stones. Bile appears in the urine and the stools are apt to become clay-colored. Itching of skin often occurs. The jaundice is not apt to be deep because the stone does not cause complete obstruction; it is apt to vary from time to time.

Charcot's fever may occur wherein an attack of colic is followed by chills, sweats and fever. It is usually of short duration. It means infection. If it is true Charcot's fever, it is the steeple type of fever and intermits and usually is due to common duct stones. If the smaller hepatic ducts become involved there is apt to be a fever which does not intermit.

Diagnosis: A case of a patient with past history of periodic colic, jaundice, fever, vomiting, clay stools and bile in the urine who now has colic accompanied by jaundice, Charcot's fever and signs of or followed by infection, presents little difficulty in the diagnosing of biliary duct stone. It is the atypical cases that need differentiation.

Stone in the gall bladder is apt to have

worse colic, to start and stop more suddenly, to be of briefer duration, to have no jaundice or clay-colored stools, to have no fever, and to have no itching.

Cancer of ducts or head of pancreas is apt to have deeper and more intense jaundice, less pain, no Charcot's fever, dilated gall bladder, itching, clay-colored stools and clinical wasting with signs of malignancy (and later cachexia).

Gastric and intestinal affections usually have no jaundice, and are not as a rule accompanied by such violent pain.

Kidney stone shows no jaundice, may have urinary changes, has different pain radiation (in the back, down the ureter and into the testicle). Cystoscopic examination and x-ray locate this stone.

Tabes has no jaundice, has eye sgins, tabetic gait, crises, vomiting which is usually relieved by morphine, positive blood reactions and evidences of past lues.

Cirrhosis of the liver has small liver, apt to have mild icterus, may be ascites. enlarged spleen, low bromsulphalein test. urobilin in urine (stones apt to have bilirubin in urine).

In the diagnosis of stones the x-rays are valuable. They may not show the stone but should always be used. The Graham dye tests are very valuable.

There is jaundice and its degree is estimated by the van den Bergh test and icterus index.

Prognosis: Stones in the common duct are more serious than if in the gall bladder and hepatic duct stones are probably more serious than either. Early treatment spares the liver and pancreas a great deal.

Treatment: When stones once form very little can be done outside of radical surgery. Diets are of no value except to put the physical condition at a better level and perhaps help reduce chances of new stones forming.

During an attack of colic morphine and atropine should be given freely and in large doses. An enema should be given. Heat to the gall bladder region is usually acceptable to the patient.

If improvement follows it is best to wait for interval operation and put patient in best condition possible. The present attack in most cases will subside in a few days.

Early operation is comparatively safe. In cases where improvement is not noted in a reasonable time surgery must be undertaken, but, as stated, where improvement occurs under treatment it is wise to temporarily postpone the operation and prepare the patient.

In a short time the fever usually abates, the jaundice partially or nearly clears, pain markedly abates, vomiting stops and the patient makes a marked clinical "come back."

Preparation for operation further consists in measures to combat postoperative hepatic toxemia and hemorrhage. The ingestion of fluids and carbohydrates including sugar and glucose in large amounts for several days before operation combats more or less the former while 5 c.c. of 10 per cent CaCl2 intravenously daily for three days before operation reduces the coagulation time and helps prevent postoperative bleeding.

The local preparation, etc., is carefully done. A right paramedian incision from costal cage to near umbilicus is probably best. Moynihan advises turning rectus out. A thorough exploration is made after opening belly. Adhesions are usually met around the gall bladder and are cautiously freed after packing off thoroughly. When the stones have been found in the ducts must be dealt with and the question of cholecystostomy or cholecystectomy depends on the condition of the patient. The gall bladder is practically always diseased and where the condition of the patient permits it is a good thing to remove it. The common duct is usually dilated and may look like the portal vein. A small needle on a syringe will soon identify the duct if necessary. The duct usually can be told by the palpation of the stones. The common duct is incised over the stones, avoiding the transverse

vein, the stones are removed and the duct explored with probe or finger up and down for further stones. (A stone low down may be pushed or worked up and got out through incision in supraduodenal part of duct. If one is unable to get it up then retroduodenal or transduodenal choledochotomy will be necessary.) After one has removed stones from the supraduodenal part of common duct a gauze strip should be passed to wipe out any sand that may be present or saline may be injected and some of it washed out. If stones are in the hepatic duct they can usually be got through this incision in the common duct by milking the duct with the left hand while a finger of the right hand inserted high up in duct is slowly withdrawn to make a suction, or by use of the small stone scoops. In cases where stones in the hepatic duct cannot be brought down they must be removed by incision.

Drainage of the ducts must always be done. A rubber tube is placed up into the hepatic ducts through the incision and the wound in the duct closed around the tube and the tube fastened into duct by a suture of catgut. A drain is then put down to the kidney pouch and to the region of the ducts and the wound closed.

The drains are removed in forty-eight hours. The tube in the duct will loosen in from ten to fifteen days and can be removed.

CASE REPORT

C. C. Pain in the gall bladder region.

Family History: Mother died of influenza in 1918. Father well. Three brothers and six sisters all living and well.

Past History: No history of childhood diseases. Had influenza in 1918 with normal recovery. Has never had typhoid, pneumonia or other serious illness. Has never had any serious injury. He was operated upon in 1927 and apparently exploration only was done. He has had two courses in typhoid prophylaxis.

Present Illness: Trouble first began suddenly in 1927 by a pain in the upper abdomen accompanied by vomiting and fainting. He immediately went to the hospital. He suffered

pain more or less for three weeks. Two days after admission he developed jaundice. He was operated upon and exploration only done. The trouble at that time gradually subsided. Previous to the attack he recalls no symptoms of any moment. Since then he has had more or less dyspepsia and has had seven or eight attacks up to now. He has suffered them out at home.

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On his admission pain is marked and severe over the gall-bladder region, epigastrium, and in the right shoulder region. There is fever, slight tint in conjunctiva, dark colored urine and vomiting. Morphine needed for pain. There are no other gastrointestinal symptoms. There are no urinary, respiratory, cardiac, or nervous symptoms elicited. He has lost about 5 lb. weight from his normal.

P. E. A well nourished adult colored male showing evidences of marked pain in the abdomen, sweating, vomiting, and a slight icteric tint to eyes and mucosae. There is extreme restlessness and anxiety. The pupils are normal. The teeth are dirty but not decayed. The tonsils are chronically diseased. There is no other pathology in the head and neck. The heart shows no enlargement, murmurs or abnormal sounds. The rate is essentially normal but respirations are 30. There are no chest findings except impaired resonance and diminished breath sounds at right lower chest. The signs are not definite of fluid. There is no inequality of expansion.

The abdomen is somewhat rigid over epigastrium and right upper quadrant. A sense of resistance suggests a mass in this region. It is tender. Murphy's sign is definitely elicited. The abdomen is not distended. There is nothing abnormal noted in the extremities except a fracture of the middle of the right fifth metacarpal bone, which gives comparatively no pain on account of the severe abdominal pain.

The fracture was reduced and splinted and morphine and atropine were given hypodermically and a hot water bag placed over upper abdomen and a snapsuds enema given. The next day the pain was markedly less but was still present. No more morphine was needed. The second day showed jaundice. A fat free diet was given. Gradually the general condition improved and on the fourth day the pain entirely stopped. The fever was not of the Charcot type. It was as shown by the fever

chart suggestive of hepatic involvement. The fever also subsided after the fourth day. The respirations dropped to normal after the subsidence of the pain.

The urine was negative on admission except for darkness of color and when the jaundice deepened on second day the urine contained a great deal of bile and the stools were light in color. The sedimentation time was 18 mm. in ninety minutes. The white blood count was 20,900 with 84 per cent polymorphonuclears, 2 eosinophiles and no stippling of the red cells. The Kahn test was negative. The stools were positive for Ascaris. X-ray of chest failed to show any fluid but some mottling suggestive of old pulmonary trouble.

A few boils developed which caused delay in operating. He was admitted November 17 and operated on December 13. During this period the teeth were cared for, the diet regulated, carbohydrates were plentifully given and plenty of fluids were taken. The worm treatment was also given during this interval. The three days before operation CaCl₂ in 10 per cent solution was daily given in 5 c.c. doses intravenously. The coagulation time on the morning of operation was three minutes, reduction of four minutes from admission date, The icterus index this same time was eighteen.

Operation: The usual preliminary local preparation was given. No cathartics were used and the bowel was emptied the night before and the morning of operation by a soapsuds enema. A hypodermic of morphine and atropine was given one-half hour before and ether was the anesthetic used. A right paramedian incision turning the rectus out was employed. Upon the opening of the abdomen numerous adhesions were found between the omentum, gall bladder, common duct, stomach, duodenum and hepatic colon. The gall bladder was enormously enlarged; it contained nearly a pint of fluid and extended about to the crest of the ilium. The adhesions were slowly and with difficult separated. A small area of the pelvis of the gall bladder was adherent to the common duct. In separating the omentum from the gall bladder by gauze stripping a small rent was made in it but as the area was well packed off no soiling occurred; the small amount which spilled was caught by a pack which was in Morris's pouch. A hemostat was placed so as to close this rent. An examination revealed an otherwise normal duodenum,

stomach and colon. The kidney was normal. The liver seemed a little enlarged and the pancreas head was a little firmer than normal. It was decided to open the common duct and as the patient was in good condition and the gall bladder was badly diseased and enlarged a cholecystectomy was done at this stage by ligating the cystic artery and the cystic duct. After removal of the gall bladder the bed was closed over with a running stitch. This gave good access to the duct. With a needle the duct was explored to make sure that the portal vein was not being opened as the adhesions had somewhat distorted structures. With the left hand the stones could be felt and were grasped and an incision made on the top and to the right in the supraduodenal region. Two large stones were removed from the duct and with the finger of the left hand on the outside and the index finger of the right hand inserted in the duct stones were felt in the hepatic duct and both its branches. None could be felt downward in the retroduodenal region. By milking the duct with the left hand and creating suction by withdrawal of the right index finger a stone was removed from the hepatic duct. A scoop inserted upward removed a stone from each branch of the hepatic duct. After this no more stones could be felt either outside or inside of the biliary tract. A stone searcher was passed both up and down. The ducts were then wiped out with a strip of gauze and considerable sand was removed. A little saline injected into the ducts washed out some more. A tube was inserted up into the hepatic duct and the wound closed in the common duct around this tube. A stitch as an anchor of the drainage tube was inserted in the common duct. The omentum was placed over the area, a drainage tube put down to the kidney pouch and operative area and the wound closed in layers. Dressings were applied, saline was given by vein and the patient returned to the ward and the tube was connected to a bottle fastened to the side of the bed. Proctoclysis of glucose and soda was started. Saline by vein was again given during the night. In the morning the condition did not seem as good as desired so glucose was given by vein.

There was considerable drainage of bile through the tube and it contained a good deal of brick dust sediment. After ten days the fever left entirely and the drainage tube loosened from the duct and was removed. For

two days after this dressings had to be changed very frequently but in a week the drainage had practically stopped from the wound and the stools began to get some color to them.

The patient was discharged January 23, 1930. The wound was completely healed, there was no drainage of bile, the stools became normal in color, jaundice disappeared, there was no pain or indigestion, the icterus index became normal, the sedimentation time became normal and the urine was free of bile.

At the present time there is complete freedom of symptoms and a gain of 10 lb. in weight.

CONCLUSIONS

- 1. Stones in both branches of the hepatic duct, the main hepatic, and the common duct accompanied by hydrops of the gall bladder without a stone or a stricture in the gall bladder are not a commonly reported condition.
- 2. The gall bladder is usually contracted when stone is present in the common duct. This case showed a strawberry gall bladder and hydrops but no cystic duct stricture or stone.
- 3. It is possible that the enlarged gall bladder may have formed at some time in the past when a stone may have been in the cystic duct and later passed on into the common duct and enlarged there; or the uppermost stone in the common duct may have been movable up and down and blocked the opening of the cystic duct into the common.
- 4. The salient features in etiology, pathology, symptomatology, diagnosis and treatment of duct stones are summarized and a case reported which if not unusual is not common.
- 5. Pain in the right upper abdomen, violent in type which is followed in a day or so by jaundice suggests stone in the common duct. When there is infection and the fever is more or less continuous and not of the Charcot type, it points to infection of the hepatic duct.
- 6. The obscure chest signs and the absence of subdiaphragmatic abscess leave the enlarged liver of hepatitis worthy of mention.

[For References see p. 528.]

THE IMPORTANCE OF A CAREFUL MEDICAL HISTORY IN DISEASES OF THE RECTUM*

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HILE the importance of a minute examination of a examination of the patient, in toto, and of his perineum and rectum, in every patient complaining of rectal symptoms, is paramount, it should not be forgotten that a careful history will add much to a knowledge of the pathology which is present. Too often we are prone to take the leading symptom as indicating a certain condition which we then may find during the examination of the patient. If we had inquired further into the history we might have been led to suspect some deep-seated or masked pathologic process which far overshadowed in importance the one which caused the prominent symptom.

Thus, a patient may complain of excruciating pain coming on after each bowel movement, leading the doctor to look for an anal ulcer, which he may find. Appropriate treatment of the ulcer will eliminate the pain and the patient will go forth happy only to turn up later in another doctor's office with, perhaps, a carcinoma. A careful questioning of this patient would have elicited some information that would have led to an examination of the sigmoid and the discovery of the malignancy.

A case in point was Mr. O., a newly married man. The patient was twenty-eight years of age, and complained of bleeding during his bowel movements and of a slight pruritus of the anus. There was nothing in his medical history or his habits of much importance from a medical standpoint except that he was very fond of water and drank a great deal of it during the course of a day. This fact, combined with the knowledge that he had some anal itching, led to a request for a urinalysis which report showed that his urine was loaded with sugar. The piles, which were causing the bleeding, were unimportant compared with the diabetes

and, as his means did not permit him to visit two physicians at the same time, he received two injections of quinine and urea hydrochloride, 5 per cent solution, to control his hemorrhoidal bleeding, and he then was placed under the care of an internist.

Many women complain of pain in the rectum and, if the statement is accepted at its face value, the proctologist will be puzzled to account for it in some cases. All of the usual causes for ano-rectal pain may be investigated and found absent. Here careful interrogation of the patient may determine that the pain is not in the rectum but is a coccygodynia. This is particularly true in a class of patients of low-grade mentality such as one is most apt to meet in a hospital clinic. Often women in hospital dispensaries will complain of pain in the rectum when they mean that they have backache. Again, lower abdominal cramps during defecation may be ascribed to the rectum. Rather generally there is a deficient knowledge of medical nomenclature among the laity and one must always remember that the word rectum may really mean the buttocks when used by one who is not familiar with medical terms.

The history of rectal bleeding should be gone into most thoroughly. What is the character of the bleeding; is it a free flow or merely a stain on the paper when the patient cleanses himself? Is it bright red in color or partially digested? Is it blood alone or is the blood mixed with mucus or with pus or both? Is the bleeding in definite relationship to bowel movements or entirely independent? For how long has this symptom persisted? All of these queries should be made and will give clues to the diagnosis or to the area deserving most thorough investigation. The gastroenterologist will think first of the hemor-

* Submitted for publication February 24, 1931.

rhage coming from the sigmoid or colon; the proctologist's initial thought will be of the rectum. It must never be forgotten that in any given case, blood may be coming from both areas.

In many ways the diagnostitian is a detective, running down clues until he solves the mystery. Like the detective, he may find misleading clues or there may be interlocking mysteries and he must be on his guard against jumping to a conclusion that seems obvious but is erroneous. A few days ago a negress in a hospital clinic received a diagnosis of gumma of the rectum because she had a four plus Wassermann reaction and a mass in the rectal wall. The doctor was misled by the positive Wassermann reaction so that he did not make the obvious and true diagnosis of rectal abscess.

The history of protrusion may lead one into error. Frequently the patient considers external hemorrhoids or skin tags as protrusion and he will say that it cannot be replaced. Overlooking the evident pathology will lead one to believe that there is a protrusion from the bowel which cannot be induced at the moment. If the patient is quizzed about the nature of this symptom, the misconception will not occur.

The symptom of pruritus or itching needs close consideration. Many sufferers from pruritus ani have an etiology far removed from the site of the trouble and sometimes this may be discovered through a good history. In another article1 the writer cited the case of a banker whose itch became worse when any local measure was attempted. It was found that the symptom made its appearance or was aggravated whenever he was worried over business and it could be controlled by sedatives given by mouth. In every case of pruritus ani and particularly in those where no local cause can be found, a careful history may lead one to the discovery of some major pathology such as a diseased appendix or gall bladder or even a carcinoma of the large bowel or elsewhere.

¹ Smith, F. C. Pruritus ani. M. Times. December, 1929.

It should be borne in mind that rectal symptoms may occur in genitourinary disease when the rectum is not involved, due to the close relationship, both embryologically and anatomically, between the two tracts. Pelouze2 tells of the case of a man who complained of a sensation in the rectum as though a bug were crawling there. After he had been unsuccessfully treated by a proctologist, a pus pocket was found in the posterior urethra and, when this had been evacuated, the unpleasant sensation disappeared. This patient had had a gonorrheal urethritis eleven years previously. Two years before he noticed a slight discharge of pus from the meatus and concomitant with this the crawling sensation in the rectum. If this history had been elicited by the proctologist, that gentleman would have been saved some embarrassment.

Recently the author was called upon to treat a woman with a typical postanal ulcer. The history showed exposure to a gonorrheal infection and smears from the anal pus revealed innumerable, intracellular, gram-negative diplococci. Without this knowledge the ulcer would have been excised in the ordinary course of treatment and the patient would have been subjected to the grave danger of a gonorrheal arthritis, which so often follows traumatism to the tissues in the presence of a Neisserian infection.

For years it has been the author's practice to have a printed history form. Under the heading of pain there are the following subdivisions: For how long; character; location; time at which it occurs. Bleeding, protrusion, swelling, itching, discharge, etc., follow with similar subdivisions. The medical history contains a list of diseases that may be checked off or after which notes may be made and there is a space for previous operations. By following this form salient points in the history will not be forgotten or omitted and the doctor will have a good foundation for beginning his examination.

² Pelouze, P. S. Gonococcal urethritis in the male. Page 301, Saunders, 1929.

NEW METHOD OF TREATING CHRONIC ULCER OF THE LEG*

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TARICOSE veins give rise to two types of chronic ulcers of the leg. The first type develops in areas surrounded by either small or large superficial veins. The pressure of the stagnating blood atrophies, stretches and eventually ruptures the skin. Frequently a thrombophlebitic process develops, spreading the infection and causing erosion of the surface of the skin and ulceration. The most effective treatment for this type of ulcer is the obliteration of the surrounding veins by injections, which was popularized in this country by Tunick, McPheeters, G. deTakàts and others. Also the compression of the veins and the protection of skin by an Unna boot gives good results. The second type of ulcers develops in a sclerosed area, in which the skin has been damaged by a previous thrombophlebitis. There are no more visible or palpable veins in the surrounding area. The injection of the veins and supporting bandages therefore are of little or no avail. The breaking up of the sclerosed tissue and a fresh supply of nourishing material is needed for the healing of these ulcers. It occurred to one of us (Tunick), that this could be accomplished by injecting the sclerosed area around the ulcer with normal saline solution. In this paper we shall review the pathogenesis and describe the technique and the therapeutical results in 25 cases.

PATHOGENESIS

The skin surrounding the ulcer is cyanotic and discolored: it is hard and cannot be raised from the base due to loss of elasticity. This change extends either over a part or the whole circumference of the limb, depending upon the extent of previous thrombophlebitis.

Histological Findings (Fig. 1): The horny layers are deficient; nucleated cells reach the surface of the epidermis (paraceratosis). The germinative layer is irregular and increased to several rows. The rete pegs are hypertrophied in some places; in others only a few layers of epidermis are present and the corium reaches almost to the surface (acanthosis). The intercellular spaces of the epidermal cells are enlarged (spongiosis). The cutis shows thick fibers and infiltration with round cells and blood pigment as a result of old bleeding. The elastic fibers have disappeared or are greatly diminished. Grave changes have taken place in the blood vessels. The back pressure from the large veins is carried through to the subpapillary branches and capillaries. The minute veins are dilated, thrombosed, and degenerated. The walls of the capillaries are fibrotic or infiltrated (Fig. 2). They have lost their contractility and elasticity. The circulation in the skin is broken down, the metabolic processes are disturbed, and therefore the resistance to infection and trauma is highly diminished.

The pressure is further increased where the skin covers bony structures. For this reason most ulcers are found over the tibiae and inner malleoli, although the skin over the whole circumference of the leg has undergone atrophy and sclerosis, in the majority of the cases. Under this pathological condition a slight injury, scratching, infection due to poor hygiene, or local phlebitis are sufficient to destroy the skin and produce ulceration. The extent and depth of the ulceration are variable, but all ulcers have in common a diminished healing power, the tendency to recur and chronicity.

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As long as the destruction of integument is still progressing, the ulcer is covered by a slough consisting of detritus and leuco-

physiological saline: the resistance we meet feels as if we are penetrating through cartilage, or better yet, hard rubber.

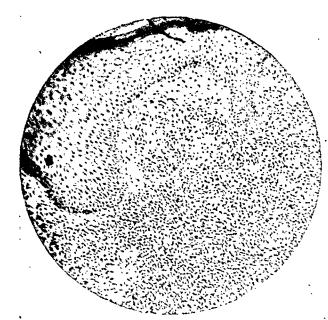


Fig. 1. Sclerosed skin surrounding ulcer, showing paraceratosis, acanthosis, and spongiosis, of epidermis, and infiltration fibrosus of corium.

and infiltration fibrosus of corium. cytes. The bacterial flora is mixed. We found staphylococci, streptococci, micrococcus, tetragenous, and gram negative bacilli, in the surface of the ulcer, and gram positive anaerobic bacilli in the slough (Fig. 3). None of these organisms is etiologically important. Usually they do not invade the deeper tissues. Progressive infection, lymphangitis or sepsis are therefore rare. The low virulence seems to be caused by the very same pathological processes which prevent the ulcer from healing, that is, the lack of nutrition. The characteristic appearance of the ulcer is fully developed, when an equilibrium is reached between the destructive and reparative processes, and the ulcer has become chronic. No noticeable improvement takes place for months or even years. The base of the ulcer is covered with glassy thin granulations, which do not reach the surface. The edges therefore are abrupt, bluish, irregular, and infiltrated. The extreme degree of fibrosis is

best realized when we try to penetrate the

ulcer with a needle in order to inject the

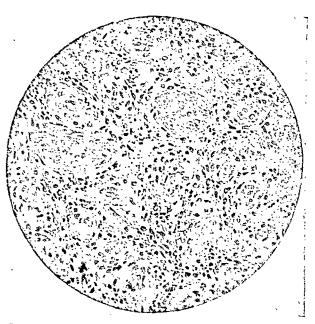


Fig. 2. Enormous thickening of walls of capillaries and occlusion.

In microscopic sections (Fig. 4) the surface of the ulcer appears to be covered with necrotic material which is infiltrated

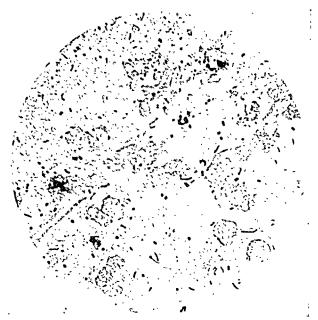


Fig. 3. Smear from chronic ulcer, showing pus cells and mixed flora of cocci and bacilli.

by leucocytes. In recent cases abscesses with large numbers of bacteria and extravasations of blocd are seen in places. The

granulations are rich in fibroblasts, plasma, and round cells. The capillaries have undergone the changes which are charac-

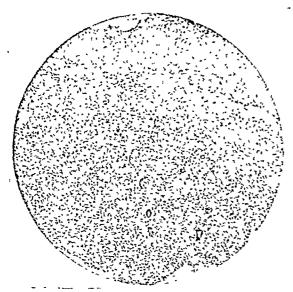


Fig. 4. Chronic ulcer, showing slough on surface, infiltration of corium, thickened and occluded capil-

teristic for the sclerosed surroundings. The capillaries are thickened, infiltrated, and thrombosed. Normal granulations undergo a continuous reduction until they are transferred into a resistant, fibrous scar, poor in cells and blood vessels. Ulcer granulations, on the other hand, are fixed at the first stages by the premature sclerozation and thrombosis of their blood vessels. They remain infiltrated with cells, and their capillaries do not undergo reduction. The metabolism is disturbed, the healing process is arrested.

PRINCIPLE OF THE INJECTION TREATMENT WITH NORMAL SALINE

Our analysis has revealed that the ulcer is surrounded by a thick ring of fibrotic tissue which shuts it off from the normal blood supply, from the rest of the body. This conception points the way for the therapy. We must break up the fibrotic ring surrounding the ulcer in order to permit formation of new blood vessels to properly nourish the diseased ulcerated area. When this is accomplished healing progresses very rapidly.

TECHNIQUE

Ulcers which are covered with dirty necrotic material and pus, and whose surrounding area is red and inflamed are first treated by a few days rest in bed with local application of mild antiseptic wet dressings, e.g., saturated solution of boric acid, Burrow's solution 1-1. As soon as the surface is fairly clean we start with the injections. The ulcer and its edges are painted with 2 per cent mercurochrome or with a weak tincture of iodine solution. A 5 to 10 c.c. Luer-Lock syringe is then filled with physiological salt solution. Twenty-two or twenty-three gauge 1 in. or 11/2 in. needle is employed. The injection is started at the edge of the ulcer; the needle is inserted until it passes the resistant fibrotic area (Fig. 5). The solution is slowly injected and continued while the needle is gradually withdrawn. If the ulcer is large, its entire circumference should be injected at about 1/4 in. intervals. The amount of solution injected varies from 2 to 10 c.c. depending upon the size of the ulcer and the surrounding fibrosis. In the beginning this procedure is frequently painful and it is advisable to anesthetize the ulcer with 2 per cent novocaine solution into the edges for the first two or three treatments. Considerable force will be found necessary in order to penetrate through the sclerosed area. Very little bleeding will be noticed from the needle puncture, in the beginning of the treatment, but after two or three treatments new blood vessels and granulations begin to form and bleeding becomes free. The treatment is repeated every three or four days until the ulcers begin to heal. The number of injections varies with the size and chronicity of the ulcer and with the extent of fibrosis in the surrounding area. During the treatment the ulcer is dressed with a bland ointment or sterile vaseline dressing. After the ulcers are healed we advise the patient to wear a supporting bandage for a few months. The healed scar of these ulcers is very strong and firm, and does not easily break

down. Sloughs produced by the sclerosing method of treatment of varicose veins are very difficult to heal. Pathogenesis

and forty; 18 (72 per cent) were in patients over forty years of age. One patient was ninety-five years. In only 2 cases did we

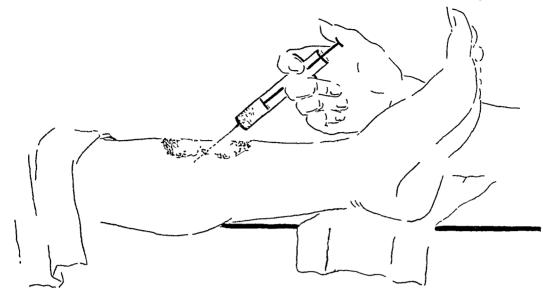


Fig. 5. The technique.

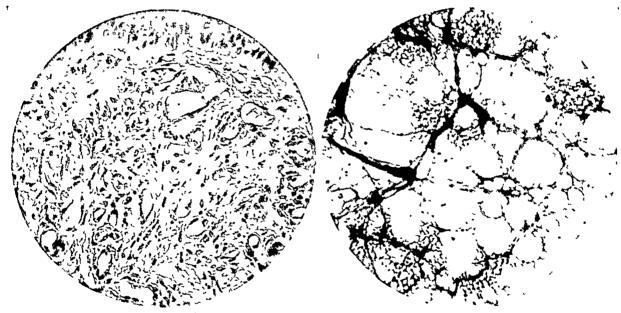


Fig. 6. Healing ulcer, covered by seam of newly formed epithelium. Numerous normal new capillaries with thick walls.

Fig. 7. Clean base of healing ulcer, with very few cocci present.

of the sloughs is the same as in the ulcer. They are surrounded by a ring of fibrotic tissue, and the base is also fibrotic. When these sloughs are treated by this method they heal very rapidly. However, in sloughs the base should be injected as well as the edges.

Of 25 cases (10 males and 15 females) treated by this method 7 patients (28 per cent) were between the ages of twenty

get a history of a considerable trauma to the leg, and these were the only two ulcers of less than one year's duration. In the other 23 cases the duration of the ulcers varied from one to thirty-four years (1 case). Two of the patients were not benefited by the saline injections alone. By applying the Unna paste boot and injecting every ten days we were able to effect a healing. We found that the number of injections varied from 1 to 20. Only one recurrence was noticed, and was evidently due to a trauma.

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The clinical course of the healing appears as follows: The edges soften, bleeding from the needle puncture is free, and pink and healthy granulations appear at the base and edges. A seam of epithelium grows from the periphery towards the center of the ulcerated area. The sections from the healing ulcer (Fig. 6) show the base clean, free from necrotic material, the infiltration diminished, rete pegs spreading over the edge. The most significant change takes place in the subpapillary capillaries. Normal vessels with a single row of endothelial lining appear instead of the thrombosed infiltrated capillaries. Smears from the ulcer reveal only few bacteria (Fig. 7).

DISCUSSION

The described method was successful in 88 per cent of chronic ulcers in indurated areas of the leg in a series of 25 cases. The technique is simple, the solution not toxic, the procedure therefore is not limited by contraindication. Of the other methods suggested for this condition, sympathectomy gives, according to Lariche, only temporary relief.

The circumcision of the ulcer has the disadvantage that it cannot be repeated, and leaves scars. Transplantation of skin is already a larger surgical procedure and often not feasible, because of the pathological conditions producing the ulcer.

SUMMARY

Chronic ulcers of the leg are caused by thrombosis and infiltration of the capillaries and stagnation in the smaller veins. A fibrotic ring surrounds the ulcer and cuts it off from the normal blood supply, thus preventing healing. Injection of normal saline solution through the edges is able to break down the fibrotic ring, and promote the formation of healthy capillaries and granulations. This method was also very successful in the treatment of sloughs, following the injection treatment of varicose veins by the sclerosing solutions, and in fact in the sloughs we treated by this method, the healing was extremely rapid.



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TUMORS OF THE CAROTID BODY*

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Tumors of the carotid body are among the neoplasms which are noteworthy for their extreme rarity, the literature dealing with these growths being indeed scant. Because of the importance of their immediate diagnosis by surgeon and pathologist, in order that proper surgical judgment may be displayed or correct therapy instituted, we feel that the report of any case of carotid body tumor is justified. Such tumors are so rare that the busiest surgeon or pathologist never becomes familiar with them through his own experience, but must learn from the collected experiences of others.

CASE REPORT

F. M. J., white, female sixty-six years of age, housewife, admitted to Hotel Dieu, complained of difficulty in swallowing, rapidly becoming worse so that she could only take liquid nourishment. This condition she attributed to pressure from a swollen gland in the neck. Although the gland had been present for one year, dysphagia was only of one month's duration. There was also associated a slight interference in speech and occasional annoying pains in the ear on the same side.

Present Illness: Began about one year ago, when a small, hard gland appeared on the left side of the neck. It caused no pain, or distress, but gradually enlarged: Not even the slightest discomfort was experienced until difficulty in swallowing presented about one month ago. Occasionally there was a slight sore throat. The appetite was poor. She lost 31 lb. in weight in one year. Past history brings nothing out that can have any bearing on the present condition.

The family history is negative for tuberculosis, cancer, cardiorenal disease and lues.

Physical Examination: On the left side of the neck there was a hard, non-painful tumor which elevated the skin about 3 cm. beyond the skin level. The mass was 12 cm. long and 3 cm.

wide. It was definitely oval in outline, the overlying skin not being inflamed. The tumor, though firmly adherent to the surrounding structures was well circumscribed, the remaining cervical glands not being involved, nor was there any appreciable enlargement of lymph nodes elsewhere. The long diameter of the tumor was on a line with the deep vessels of the neck. General examination by the medical consultant showed an old lady in very poor physical condition. Blood pressure 258, systolic, 120 diastolic. The heart was enlarged, with permanent damage to the muscle and endocardium. The aortic second sound was accentuated and there was a soft systolic blow at the second right interspace near the sternum. Lungs and abdominal organs are negative.

The final report of the consultant was as follows: "Malignancy of cervical glands possibly secondary. Prognosis is hopeless. Even if blood pressure did not contraindicate operation, in my opinion, operation would be useless."

Clinical Laboratory Examinations: Blood: Total white cell count 7250. Differential count; neutrophiles 64 per cent, small lymphocytes 33 per cent, large lymphocytes 2 per cent, eosinophiles 1. Wassermann reaction of the blood negative.

Urinalysis: 1.5 per cent albumin. No casts present. Phenolsulphonphthalein excretion 25 per cent in two hours. X-ray of thorax shows no glandular enlargement and only slight enlargement of the heart to the left.

Preoperative Diagnosis and Indications for Operation: Malignant neoplasm of the left side of neck.

Indications:

1. The surgeon had a similar case four years ago, occurring in a female, sixty years of age. On thorough removal of the tumor, the patient entirely recovered and is living today. The pathologist at that time reported the growth as sarcoma, although the symptons, course and location were identical with that in the case here reported. No sections of the gland were preserved.

^{*} From the J. T. Nix Clinic, New Orleans, La. and the Departments of Surgery and Pathology of the Medical Center, Louisiana State University, New Orleans, La. Submitted for publication December 3, 1930.

2. There is no evidence of extension or metastasis of tumor. It is apparently primary at this site.

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were approximated with interrupted catgut. Interrupted silkworm gut with a continuous dermal suture was used for the skin. The



Fig. 1. Paraganglioma caroticum. Low power, showing histologic analogy to normal carotid body. (Nix-D'Aunoy.)

- 3. In all directions beyond the tumor margin apparently healthy tissue is present.
- 4. The patient requires immediate relief as she can scarcely swallow.

Description of Operative Technique and Findings: A long incision was made extending from below the ear to the clavicle following the line of the anterior border of the sternocleidomastoid muscle. The muscle was adherent to the mass below and a large part of the muscle was excised. The tumor saddled the common carotid, beginning about 2.5 cm. below the bifurcation and extending about 0.75 cm. beyond, surrounding each branch. It was removed with little difficulty. Anticipating possible injury to the common carotid artery, a piece of heavy silk was thrown around the vessel, but it was not tied. The deep jugular vein was divided between ligatures. The external carotid artery was also divided between ligatures. A rubber tissue drain was left in the wound; the muscles

operation was started with a local anesthetic but supplemented with ethylene and oxygen.

Gross Observation of Excised Tissue (from the records of Hotel Dieu, New Orleans): A mass of tissue about the size of a golf ball, irregular in outline and markedly lobulated, giving the impression that it is composed of a mass of glands matted together. On section, the tumor is firm in consistency and mottled, of ivory white and transluscent gray appearance. Every one of the constituent (tumors) the largest of which is the size of a pigeon's egg and the smallest the size of a small marble, shows the same general characteristics.

Microscopic Observation: The tumor has practically the same histological structure as that of a normal carotid body, a sinusoidal arrangement enmeshing epithelial-like cells varying in size but generally rather large. Most of these individual cells are polyhedral in shape with abundant granular cytoplasm

and rather large chromatic nuclei (Figs. 1-2). Here and there less differentiated cells resembling neuroblasts are seen. No ganglion cells

the movements of the neck were not interfered with. There was no pain or discomfort, no difficulty in swallowing or talking. Blood

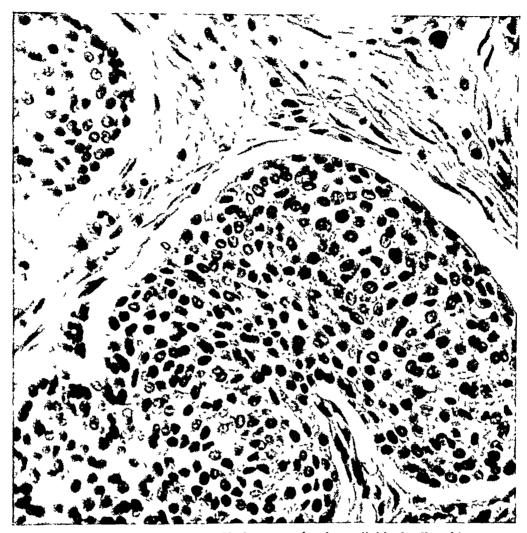


Fig. 2. Paraganglioma caroticum. High power, showing individual cell architecture

or nerve fibers are demonstrable after application of either Van Gieson or the modified Bielschowski methods. Peripherally the cells show activity as evidenced by deeper staining reaction and some mitoses.

Final Microscopic Diagnosis: Paraganglioma caroticum.

Progress Notes: Recovery was uneventful. The drain was removed on the third postoperative day. Dermal sutures were removed on the eighth postoperative day and silkworm gut sutures on the twelfth postoperative day. The wound healed by first intention. The patient left the hospital on the twelfth postoperative day.

Follow-Up Notes: The patient was seen three months after operation. The wound had entirely healed, leaving a thin, firm line of incision. There was evidence of some loss of muscle, but pressure showed a decided drop, the maximum being 210 systolic, and 110 diastolic. Two months later the blood pressure was 190 systolic, and 110 diastolic. The patient felt well and was doing her own housework. There was no evidence of recurrence. The heart sounds were not as accentuated and harsh as before operation, and her general condition showed improvement.

We shall not attempt a review of the literature relevant to carotid gland tumors, due to the fact that this has been recently done in a most thorough manner by Bevan and McCarthy, in reporting a case of their own. These authors were able to collect 131 cases which they reviewed with much detail. They feel that the valuable lesson to be learned from their study is that surgical removal of such tumors is to be undertaken only when it is not necessary to ligate the carotid arteries in order to complete the operation, since 30 per cent of such ligations have terminated fatally, and in a certain percentage of cases, ligations have been followed by permanent aphasia and hemiplegia. They stress the fact that more than 80 per cent of these tumors are certainly benign. The remaining percentage they feel probably includes lymphosarcomas and other malignant tumors of the neighboring tissues, which involved the carotid gland incidentally rather than originated in it. Since a procedure which offers a 30 per cent mortality risk is not to be considered in treatment of a benign tumor, and a malignant growth whose removal would necessitate the ligation of the carotids would give little prospect of a permanent cure, they conclude that removal of the tumor is justified only when such ligation is unnecessary. In their own case, x-ray therapy produced practically a cure, the tumor mass disappearing almost entirely with the patient free from symptoms thirteen months later. This leads them to the statement that "treatment with x-ray, with its very slight danger, is to be preferred to the operative treatment of these tumors which carries with it the enormous mortality of 30 per cent."

EMBRYOLOGY

The embryology of the carotid body has called forth much discussion which we shall not even attempt to recapitulate. The three theories which have been most prominently advocated are that it originates:

- 1. From the anlage of the sympathicochromaffin system (Zuckerkandl, Stilling, Kohn).
- 2. From the third or fourth branchial cleft (Stiede, Rabl, de Meuron).
- 3. From the perithelium of the carotid arteries (Kastschenko, Paltauf and Monckeberg).

The general concensus of opinion at the

present time appears to favor the first theory. Sullivan and Fraser mention, "the neuro-epithelium from which the carotid body is derived," and base their discussion of carotid gland tumors on this premise. They state that "there can be little question that the carotid body represents one of the paraganglia of the sympathetic nervous system of which for instance the medulla of the adrenal gland is another and the best known,"

GROSS ANATOMY AND HISTOLOGY

The carotid bodies are usually two in number and are situated on either side, posterior to the common carotid artery at its point of bifurcation. They are of a brownish red color, oval in shape and average about 5 mm. in their long diameter. Their size and shape have been compared to a grain of rice (Jordon). Callison and Mackenty state that they are found in embryos 20 to 30 mm. in length and may be absent on one or both sides in embryo or in the adult. They reach their full development between the ages of twenty to thirty, and remain stationary for a period after which the interlobular blood vessels thicken, and sclerosis and atrophy of the organ results.

Careful description of the organ was given by Luschka in 1862. He and other writers recognized its intimate relation to blood vessels and nerves and due to this it has been named at various times the "globus caroticum," "ganglion inter-caroticum," and "paraganglion caroticum." Gray states that "the gland is invested by a fibrous capsule and consists largely of spherical or irregular masses of cells, the masses being more or less isolated from one another by septa which extend inward from the deep surface of the capsule." Jordon says that these masses of parenchyma are epitheloid cells. He describes the cells as "ovoid with finely granular cytoplasm and a spheroidal, somewhat vesicular nucleus," and states that many of them contain chromaffin granules. They have an alveolar arrange-

ment and lie in intimate relation with the capillary tufts with which they are richly supplied. The function of this gland, according to Jordon, is obviously similar to that of other organs of the chromaffin system and probably chiefly dependent upon the presence of adrenalin. Due to its genetic relationship and histologic similarity to a sympathetic ganglion, Kohn proposed the name "paraganglion caroticum."

According to Callison and Mackenty. the rich nerve supply of the organ is derived from both the central and sympathetic system, it receiving branches of the vagus, glossopharyngeal, superior laryngeal, and superior cervical sympathetic ganglion, which nerves form a plexus on its anterior surface. The capsule is rich in medullated and non-medullated fibers which penetrate it and the stroma from the plexus, interlacing intimately with the cell masses and capillaries. Here and there in the body of the organ a few scattered areas of ganglion cells are to be found.

PHYSIOLOGY

The physiology of the carotid body is not definitely known and the experimental work on the subject, the vast majority of which is not recent, is contradictory. Most of the work has been done on the premise that as a type of the chromaffin system its function deals with the regulation of blood pressure.

The organ is not constantly present, and its absence or removal apparently produces no noticeable symptoms. We incline to agree with Frugoni, who after a vast amount of experimental work doubted the existence of any important internal secretion originating from this body. In the case we report, however, there has been a very definite and sustained fall of both the systolic and diastolic blood pressure after the removal of the diseased organ.

PATHOLOGY

The pathology of the carotid body is limited for all practical purposes to the

tumors, arising from it. These tumors vary in size from a few millimeters to 8 or 10 cm. in diameter, and vary in consistency from hard to soft, depending on the predominance of fibers or cells. Descriptions of the appearance of the reported tumors is strikingly similar, the variations which do occur being in color, density and arrangement, depending on which of the elements, capillaries, connective tissue, or cell rests, is predominant. The tumors are well encapsulated by a rather thick fibrous capsule and with dense fibrous trabeculae giving the external surface a rather nodular appearance with the trabecular ramifications dividing the interior into a series of lobules so that the surfaces presented after sectioning give an appearance which has been compared to fish-roe.

The most interesting discussion of the pathology of carotid body tumors is undoubtedly that of Sullivan and Fraser. They state that there are two types of these tumors representing the two most common differentiating neoplastic forms of the neuroepithelium from which the carotid body is derived. The more frequent histological type found as is generally admitted, is that which simulates closely the structure of the normal carotid body," a sinusoidal arrangement of the alveoli of fully differentiated paraganglion or chromaffin cells." The other group of these tumors include those which have been described by various authors as "sarcoma," "sarcoma-like," "psuedo-sarcoma," "endothelioma," "perithelioma," etc., the very multiplicity of these names suggesting the uncertainty of their nature. Sullivan and Fraser feel that:

At least some of these various histological pictures represent different stages of cell maturation in another line of differentiation of the neural crest epithelium from which the sympathetic nervous system is derived, for example, neuroblasts, giving rise to neuroblastomas or capsule cells or perhaps Schwann sheath cells giving rise to neuro-blastomalike tumors without true ganglion cells or axis-cylinders.

Sullivan and Fraser conclude that these types of tumors are neuroblastomas or at least varieties of neuromas and not tumors of fibroblastic or endothelial origin. The first type they consider as paragangliomas. They stress the fact that in the differentiation of the tissues derived from neuro-ectoderm there are several resting rearrangement stages before the development of the ganglia and paraganglia of the sympathetic system is reached, these stages tending to give rise to neoplasms which, depending on their stage or origin, may be termed ganglioneuroma, paraganglioma, chromaffinoma or neuroblastoma. Since the first type of tumor is a faithful reproduction of the normal carotid body there could be no objection to the term "paraganglioma" unless the question were raised to doubt its nature as a true neoplasm and to consider it as rather a hyperplasia similar to that encountered in the thyroid in certain goiters, for instance. Sullivan and Fraser, however, dismiss this issue by saying that the latter condition may exist, but that in their case and in many of the cases recorded in the literature, the tumor showed central degeneration and peripheral growth which proved it to be neoplastic. Such can be said for the tumor herein reported.

Most authors agree that both types of the tumor may undergo malignant metamorphosis, the second group more frequently so than the first. However, we are inclined to agree with Royster, that carotid body tumors must be regarded as benign tumors, as they are usually of slow growth, perfectly encapsulated and do not give rise to metastases, or recurrences, when occurring being the result of incomplete resection at operation, with continuity of growth. The term "perithelioma" so frequently used in designating or describing these tumors, we consider inappropriate, as perivascular arrangement may conceivably appear in tumors of a most diversified nature. Further we even doubt the existence of perithelium in the sense of distinct cell elements or cell types.

DIAGNOSIS OF CAROTID BODY TUMOR

The diagnosis of carotid body tumor previous to operation is very difficult, as is evidenced by the fact that very few of the recorded cases were so diagnosed. The tumor is typically painless, of slow growth and present in the superior carotid triangle. The patient is usually prompted to consult a physician due to the noticeable tumor mass or pressure symptoms caused by it. Clinically it must be principally differentiated from the following conditions:

- 1. Primary lymphosarcoma
- 2. Metastatic carcinoma of the lymph glands
 - 3. Aneurysm
 - 4. Gumma
 - 5. Tuberculous cervical adenitis
 - 6. Aberrant thyroid.

The positive diagnosis of tumor of the carotid body cannot be made except by the pathologist after a study of miscroscopic sections. It may be assumed by the surgeon, but is impossible of differentiation from malignancy or some of the previously mentioned morbid processes.

TREATMENT OF CAROTID BODY TUMORS

The treatment of these tumors offers subject for much discussion. For many years, surgeons have recognized the fact that operative interference in these cases usually means ligation of the common carotid or one of its branches, which procedure carries with it in any case a high operative mortality. On these grounds numerous writers have warned against surgery in any but early cases in which the tumor can be removed without sacrifice of the great vessels. Other writers take the contrary position. Royster states that "prompt recognition and early removal even at the expense of resection of the large vessels appears to be the only rational plan." He further adds that, "no case successfully treated by medication or radiation has so far been recorded." Since this statement, however, Bevan and McCarthy have published their case successfully treated by x-ray. This report will undoubtedly stimulate other workers to similar attempts.

Sullivan and Fraser feel that "treatment can only be surgical." They subjected their 2 cases to surgery and state that they are vindicated by the fact that both tumors showed active growth and possible malignant tendencies, and that at the time of their report, several months postoperatively, the patients were free from symptoms.

We believe that with an established diagnosis, unless urgency of symptoms as was presented by our case indicates surgical intervention, that undoubtedly early resort to the x-ray should be had. In this respect, however, we desire to again call attention to the irrefutable fact that biopathologic examination alone can reveal the true nature of a growth encountered in this region. The condition should therefore be treated as would a malignant growth encountered elsewhere, and although radium and x-ray therapy have apparently established cures in some of the proved cases, the same methods have likewise proved efficacious in a greater or less degree with malignant growths in general. In general it may be said that surgery is undoubtedly the treatment of choice, supplemented with later x-ray or radium therapy.

SUMMARY

- 1. A case of paraganglioma of the carotid body, with symptoms of over a year's duration and with successful surgical removal is reported.
- 2. Embryology, anatomy, physiology and pathology of the carotid body are briefly discussed.
- 3. Since accurate diagnosis is impossible in these cases without biopathologic examination, surgery is the procedure of choice supplemented by x-ray or radium.

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LOCAL REDUCTION OF FRACTURES OF THE TIBIA AND FIBULA

REPORT OF FIFTY CASES*

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THE purpose of this paper is to put into practical form, a simple method for reduction of fractures of the tibia and fibula, but more especially fractures of the shaft of one or both.

In my opinion, the first thing of importance in the treatment of all fractures, and especially those of the lower leg, is the immediate reduction of the fracture. This should be done, if at all possible, within an hour or two after the injury. The following procedure is carried out in the order named.

- I Each patient is give a quarter (14) grain of morphine.
 - 2. A temporary splint is applied.
- 3. An x-ray picture, both anterior, posterior and lateral, is taken.

After the x-ray has been taken, the leg is first cleaned thoroughly and shaved. green soap, ether, and alcohol being used in the order named. The site of fracture is injected even though there is no displacement of fragments, because by so doing the patient is free from all pain during the process of putting on the cast. Ten to forty cubic centimeters of a 2 per cent solution of novocaine is injected into the hematoma, or hematomas, at the site of each fracture shown on the x-ray plate. Great care should be taken in injecting the novocaine in the hematoma that blood is returned into the syringe before the injection is made. It should be understood that the hematoma of every fracture must be injected in order that the patient be free from all pain. After the injection is complete at least fifteen to twenty minutes should elapse before further procedure and in cases that are not seen for five to ten hours after the accident you should wait at least thirty minutes or

more, the reason being that the hematoma is more organized, the result being that the novocaine is not as well distributed. A 4 in. piece of muslin bandage is then used to apply a clove hitch about the ankle of the patient, the ends of which are tied about the waist of an assistant, whose weight serves to help produce a steady traction on the leg while the rest of the procedure is carried out. As this traction is applied the muscles will be found to be perfectly relaxed and the patient will be completely free from pain. If swelling is present which in some cases occurs at once, but in most cases does not occur for an hour or more, it is necessary to massage the leg thoroughly and carefully, the result being that by ten or fifteen minutes of careful massage that all or nearly all of the swelling can be eliminated. If at the time this traction is applied, the patient complains of pain, it is because the novocaine has not entered into the hematoma at the site of the fracture, or fractures. As this pull is applied by the assistant it takes a relatively small amount of manipulation to put the bones into perfect anatomical position. This can be determined by the use of a fluoroscope under which the entire reduction is done. When the fragments are found to be in satisfactory position one is then ready to apply plaster bandages to the leg. The plaster is applied directly to the skin which is contrary to most teachings. This is done by first applying a plaster bandage which is made by several thicknesses of plaster of Paris bandage being placed on a board. This bandage is applied from a distance of about 6 in. above the knee, posterially, down to the bottom of the foot to a distance of about 1 in.

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above the toes. Great care is taken to see that it is applied very smoothly and that there are no wrinkles in the bandage; also that it is cut at an angle under the ankle so that there is an overlapping at the ankle rather than a wrinkle. Plaster is then applied circularly over the entire leg from a distance of about 6 in. above the knee to the toes, care being taken to apply the plaster evenly and snugly but not too tightly. By "not too tightly" we mean to merely place the plaster about the leg but not to roll it or put any pull on the plaster bandage. The plaster is applied with the clove hitch and traction still intact, the leg being examined from time to time under the fluoroscope to see that proper position is maintained at all times. The walking iron as designed by Dr. Forrester is incorporated into the cast, care being taken to see that it is parallel to the axis of the tibia. (For description of the walking iron, see Fig. 1.) As soon as the plaster has fully hardened, an x-ray picture is taken to see that proper anatomical position is present. If the bones are in good apposition the clove hitch is removed dorsally, by cutting the edge of the cast. If the clove hitch is left under the cast a pressure necrosis would result. The patient is then put to bed and the foot elevated on two to three pillows, with instruction to both the patient and the nurse to see that the toes are moved at regular and frequent intervals, the purpose of this being to eliminate any swelling that may result. By this procedure, I have not as yet had to remove but one cast and in this case it was due to a roughening of the cast which could have been eliminated had I applied the cast smoothly. The patient is allowed to put his full weight on the walking iron in three to four days with the aid of a crutch or cane and in some cases without any support, the full weight being borne on the broken leg, the weight falling on that part of the leg above the fracture. Walking on the leg does not cause the patient any great amount of discomfort and does not endanger the position of the fragments.

This is true in all cases excepting those cases where the upper end of the tibia and fibia is broken into the joint capsule. This

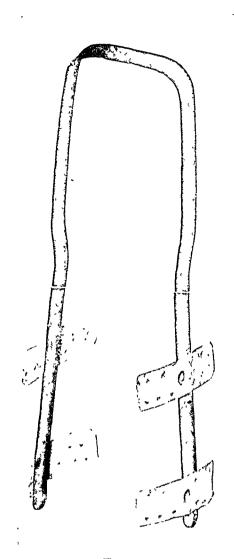


Fig. 1.

method which I have described applies only to fractures which are sufficiently transverse so as to allow the edges to become hooked.

TREATMENT OF FRACTURES, THE FRAGMENTS
OF WHICH CANNOT BE HELD IN
POSITION BY THE CAST ALONE

In these cases where there is a long oblique fracture of the tibia, it is necessary to hold the fragments in place by a steady continuous pull on the leg. This is best done by the use of a Steimann nail through the os calcis on which sufficient weight is applied to keep the fragments in position

as shown by x-ray examination. After this traction has been applied and maintained for approximately fourteen to twenty-one days, a cast is applied and the leg treated as in the case of an ordinary transverse fracture of the shaft.

TREATMENT OF COMPOUND FRACTURES

Compound fractures are treated in the same manner, with the following exceptions:

The injection of novocaine is made from the side opposite the wound and around the entire site of the fracture, by the use of a long fine needle. The wound is treated as follows:

The wound is cleaned thoroughly with green soap and ether and a debridement is done as completely as possible, after which the wound is cleaned with a solution of iodoform in ether in the proportion of 2 dr. iodoform to 1 oz. of ether. The skin is closed with silkworm gut and the fracture treated as if it were a simple fracture. No window is left in the cast although the patient is watched very carefully for the development of gas-bacillus infection. It is routine procedure to give 100 c.c. of Lederle's gas-bacillus antitoxin in all cases where the wound has been exposed to

(street dirt). In only I case has it been necessary to remove the cast and treat the infection of the skin, which fortunately did not result in osteomyelitis.

ADVANTAGES OF THIS METHOD OF TREATMENT

- 1. Elimination of the dangers of anesthesia in such cases as pulmonary tuberculosis, hypertension, cardiorenal and cardiovascular conditions, etc.
- 2. More complete relaxation of the muscles and better resulting anatomical position with a longer period of manipulation possible inasmuch as the anesthesia lasts from two to two and one-half hours.
 - 3. Shorter period of hospitalization.
- 4. No atrophy of the muscles of the leg because of the patient's being allowed to walk much sooner and because the normal circulation to the parts is maintained there is less fibrosis and no resulting osteoporosis.
- 5. Lessened chance of non-union due to decreased circulation.
- 6. Shortened temporary disability and lessened permanent disability.

In writing this paper, I wish to express my appreciation to Dr. C. R. G. Forrester for the help that I have had from him in the treatment of fractures by this method.



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PRIMARY SUTURE OF COMPOUND FRACTURES

REVIEW OF 70 CASES*

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THE first consideration of any treatment of fractures must be the saving of the patient's life, next the preservation of the extremities, and lastly to restore, in the shortest time possible, the function of the injured part. Compound fractures greatly increase the difficulties of accomplishing any of these aims.

Theoretically, the ideal treatment of compound fractures would be to convert them into simple fractures. Last year while working in the wards of Mr. Donald Duff, surgeon in the Royal Infirmary, Glasgow, Scotland, I had an opportunity to observe the results of primary suture of compound fractures. With his permission, I am publishing the results which his group obtained in a series of 80 consecutive compound fractures occurring in 70 individuals.

The compound fractures were usually the result of greater trauma than simple fractures. Many were associated with other injuries, which made them more serious. In this series, 12 were compound skull fractures, associated with brain injury. Two of these patients died within twelve hours. Of the remaining 10, 1 died of septic meningitis following excision and packing of the wound. The other 9 were treated by debridemont, removing the dirty bone fragments and suturing the wounds. One of this number became infected, developed a hernia cerebri, but recovered. There were 12 patients who had more than one compound fracture. Five were complicated by simple fractures

The compound fractures were usually the result of a direct force and were much more common over the superficial bones.

Over 75 per cent of the compound fractures were the result of direct violence.

However, many compound fractures of the upper extremity were caused by indirect violence.

Table 1									
Location of Fractures	Number	Per Cent	Direct	Indirect					
Tibia and fibula.	27	33.75	22	5					
Skull	12	15.0	12						
Tibia	10	12.5	4	6					
Foot	6	7.5	6						
Humerus	4	6.25	τ	3					
Femur	4	5.0	4						
Hand	4	5.0	4						
Radius and ulna	3	3.75		3					
Ribs	2	2.5	2						
Astragalus* Fibula, ulna,	2								
pelvis	I	1.25							

^{*} Fracture dislocation.

We must examine this series as to the deaths and the causes of death. There were 7 deaths. Two patients died from shock and hemorrhage; 2 died within twelve hours as a result of brain injury; I died of meningitis, following a compound fracture through the frontal sinus. The sixth person died from bronchopneumonia combined with brain injuries, four days after admission. One patient having fracture of the pelvis died of internal hemorrhage. The first patient died upon the table while the surgeon was cleaning the wound. The second person died thirty minutes after an anterior racket amputation of thigh was done. This patient's life might have been saved if a blood transfusion had been given immediately before operation. There were no deaths attributable to sepsis following suturing the wound. One patient died of internal hemorrhage; no operation was performed.

There were 8 amputations, 4 primary and performed because of the extensiveness

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of the fracture and the great injury of the soft parts. Two amputations were performed because the blood supply of the extremity was insufficient and the part

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TABLE II CAUSE OF DEATH

Type of Fracture	Cause	Deaths
Vault of skull through the frontal sinus Lacerations of femoral yessels, fracture of	Meningitis	1
shaft of femur	Shock, hemorrhage	2
	Brain injury	2
Vault of skull	Brain injury Bronchopneumonia	ĭ
Fracture of pelvis	(n	1

became gangrenous. Two secondary amputations were necessary to control spreading virulent infections in the wounds.

TABLE III AMPUTATIONS

Cause of Amputation	Primary	Secondary'	Deaths

Bone shattered, great injury of soft parts. Insufficient blood sup- ply. Infection	4 2 	2 2	I

The average length of time spent in the hospital was 44.5 days for all this series of compound fractures. Only 3 persons were treated expectantly but these patients averaged fifty-nine days. The length of stay of patients having compound fractures which became infected was 62.5 days. While the number of persons treated expect antly was small, their average stay was 14.5 days longer than that of the whole group. Taking 100 compound fractures in one year, the hospital would save 1450 hospital days, an enormous saving from an economic standpoint. Furthermore, the average was somewhat increased by the fact that there were 10 secondary operations, performed with an average time of 59.75 days. Two were amputations for

infection; 5 were for the removal of sequestra; I was a skin graft to repair the damage resulting from a sluff of skin: 2 were for malunion.

TABLE IV AVERAGE LENGTH OF TIME IN HOSPITAL

Type of Treatment	Number of Fractures	Days in Hospital
Debridemont plus primary		
suture	77	44.5
Debridemont	3	59
Infections	10	62.5
Secondary operations	10	59.5

Nonunion, delayed union, and malunion are supposedly much more common after compound fractures than simple fractures. In this series nonunion did not occur. Delayed union appeared in 2 instances, and malunion twice. We have been taught that sepsis tends to delay the healing of the fracture and results in these conditions. It is interesting to note that the delayed union occurred in clean fractures. Nonunion is almost always caused by too zealous removal of the splintered portions of bone, leaving a gap which cannot be bridged by the bone. It was prevented in this series by the preservation of all the bone splinters possible and by the suturing of the soft parts over them so as to give them the best chance of life. Delayed union is more apt to occur in transverse fractures with very little comminution.

These patients were seen first in the gate house of the Royal Infirmary. The external dirt and filth were cleaned from around the wound and the skin painted with methylated spirits, followed by iodine. A splint was placed upon the extremity and the patient was sent to the wards. No attempt was made to reduce the fracture. In the wards the patient was treated for shock with electric cage, hot drinks, morphia. Antitetanic serum was administered at this point.

That night the patient was taken to the operating room. The wound was thoroughly cleansed with ethereal soap, methy-lated spirits, and iodine. Any dirty fragments of bone were clipped off by a rongeur or chipped off by a chisel. A debridement of the soft parts was done, all bleeding stopped. The fracture was reduced, the skin loosely stitched with silkworm gut. A splint was applied, and the patient sent back to the wards.

If no infection developed, the wound was treated by dry dressings and the fracture as a simple fracture. If the patient began to complain of a good deal of pain in the wound, associated with increased temperature, the wound was examined. If the edges were reddened and edematous the stitches were removed, free drainage was established, and the treatment proceeded as that of an infected wound.

There were to infections in the 80 compound fractures. Three were slight, not requiring the removal of the stitches. Three infections occurred in wounds in which foreign bodies were introduced: two in which the bones were wired with silver wire, and the other in a wound in which a Lane's plate was used. Two occurred in very bad crushing injuries of the foot, in which it was impossible to do a thorough debridement without amputating the foot. Both men had useful feet in spite of the infection. One occurred in a depressed fracture of the skull in which a portion of the left frontal lobe was left upon the fender of an automobile. It was impossible to remove all the dirty and bruised tissue from this wound. This child developed a hernia cerebri, but after a long period in the hospital was discharged apparently well, but with a large defect in the frontal bone. In two of the infections, the process was so severe that amputation was required, the patients losing their legs but not their lives.

Statistics are not very reliable. Two people reading them get entirely different impressions. From the study of these patients and the observation of them in the hospital, I have tried to form a fair opinion of this method of treatment.

In the first place, the results of this series are inferior to those obtainable by a good surgeon in private practice for the following reasons: (1) The streets of Glasgow are always covered with a lot of dirt, horse manure, and filth not found in American cities. (2) It was the custom to operate upon these patients at the end of the receiving day; thus the operations were performed from one to twenty-three hours after the accident. (3) The results seemed to depend upon the thoroughness of the debridement. (4) The patients of this hospital were often very dirty and wore quantities of filthy underwear. (5) Due to poor food, housing, and climatic conditions, the resistance of the individuals to infection seemed lower than that of patients seen in private practice. And, (6) due to the large number of patients, many of these individuals were dressed and taken care of by the nurses with some supervision by the surgeons.

This is not a method to be adopted by every practitioner or surgeon. It requires a skill and judgment not possessed by every operator, and a careful technique not possible to carry out without a thoroughly trained operating room staff. Used in selected fractures I believe it is the best method of treating compound fracture.

It is the method of choice in compound fractures due to indirect violence, and in those due to direct force in which there is not too much bruising and laceration of the soft parts, including the skin. It should be done in all compound fractures of the skull. It should be done in all compound fractures in which the main blood and nerve supplies are intact. It is the method of choice in these fractures if seen within six hours of the injury. It is not the method of choice in fractures seen after this time, in very extensive lacerations and contusions in which it is impossible to remove all the injured tissue without gravely injuring the function of the limb, in cases in which debridement is not complete, where it is impossible to check the oozing, in places in which a

thorough debridement would sacrifice main blood vessels or nerves, or in the face of obvious pyogenic infection within the wound or in other parts of the body. Debridement alone should be used in groups not suitable for primary suture except in obviously infected wounds.

The technique I believe to be the best for the first group is the following: When first examined, no attempt is made to reduce the fracture. The area around the wound is shaved, cleaned with alcohol and benzine, and painted with 3.5 per cent iodine, a sterile dressing, a splint applied, antitetanic serum given, and the patient is sent into the hospital where he is treated for shock in an electric cage, with heat, saline, fluids, morphia for pain, and a blood transfusion if necessary. After he has recovered from shock, he is taken to the operating room. The patient is anesthetized, the wound and surrounding parts being cleansed with ether and green soap, alcohol, and 7 per cent iodine. The iodine is allowed to dry. Then the excess is removed with alcohol. The patient is draped and the operation proceeded with, using rigorous asepsis, all tissues, sutures, sponges, being handled by instruments instead of the fingers. Keep the fingers out of the wound. A longitudinal elliptical incision is made around the fracture wound, conserving as much of the skin as possible. The incision must be long enough to permit easy exposure of underlying structures. The knife is now discarded and fresh towels are clipped to the wound edge. The edges of the wound are opened widely and a generous excision of the subcutaneous tissues is carried out. The fat is of no value in the closure and any damaged fat tends to promote infection. When the deep fascia is reached, one is more economical, making the incision parallel with its fibers and removing only a narrow ellipse around the wound. Below the fascia one must exercise great care. All the great vessels and nerves lie in this region. They are inspected, and if damaged suitable steps are taken to repair them. Damaged muscle tissue is

removed, but as much normal tissue left, as possible. It is necessary to remove all muscle tissue which does not bleed, or only very slightly, and does not contract when pinched. The edges of the bone are chipped off with a chisel. All obviously dirty fragments are removed, unless they are very large, thereby leaving a serious bony defect, in which case they are treated as the dirty ends of the bone. All other fragments are left in the wound, even if detached, for they act as chip grafts in the wound. It is essential not to leave the wound open if this is practiced, because in an open wound they all die and have to be extruded. The wound must not be probed with instruments or the finger. Also, the operator must be careful not to leave any portion of the sinus tract which may have been hidden by the shifting of the sinus's position, either by contraction or relaxation of the surrounding muscles. This, I believe, can be accomplished by doing as thorough a debridement as possible, then pulling the bony fragments in as good a position as possible. This will probably reveal any hidden portions. At any rate, the maneuver will obliterate much dead space and minimize chances of infection. It is not wise to try to manipulate the fragments into place by the use of instruments introduced into the wound because of the danger of causing new traumatism of soft tissue and opening new avenues of infections. Absolute hemostasis is necessary. The skin is then closed loosely with interrupted sutures of silk-

worm gut. All other compound fractures except the obviously infected ones are treated by a thorough debridement, but no attempt made to close the wound by primary suture. If infection develops, it is treated by the Carrel-Dakin method.

Obviously infected compound fractures must suffer as little meddling as possible. Debridement is contraindicated. The fracture must be reduced to get rid of the large cavities which lie between the displaced fragments and which are apt to give rise

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to abscess formation. After reduction, the blood vessels which have been compressed and displaced by the fragments are again free and the blood supply to the extremities is improved. Then the fragments must be completely immobilized and kept so. There is no greater mistake the surgeon can make than that of removing the splints when infection occurs and only treating the wound as such. Very few treat an abscess by sticking a finger into the cavity and moving it around at a great rate. Yet that is what a surgeon does when he fails to immobilize the infected fracture, and he need not be surprised if the patient has a chill after a dressing or if the patient succumbs from a general septicemia. Provision must be made for adequate drainage. The incisions are guided by anatomical reasons and are not always placed in the most dependent part. All pus accumulates in fascial planes and rarely perforates the strong fascia. Particular care must be exercised in avoiding large vessels for if drainage is too near the blood vessel, the latter may be eroded and the patient may die of secondary hemorrhage. If later, it becomes necessary to make additional incisions for drainage, the fracture must be kept reduced and immobilized throughout the operation; otherwise it may lead to a displacement of the fragments and a

change in the course of blood vessels and nerves may result, and the latter be injured by the incision. Irrigations of warm Dakin's solution are helpful.

CONCLUSIONS

- 1. Primary suture is not safe for the general practitioner or occasional surgeon.
- 2. Debridement should be practiced within six hours of the injury.
- 3. The results will depend upon the thoroughness of the debridement.
- 4. Debridement plus primary suture is the operation of choice in compound fractures due to (a) indirect force, (b) direct force without a great loss of tissue, (c) skull fractures, and (d) in comminuted fractures without too great a loss of soft tissue.
- 5. Debridement and Dakin's treatment are indicated in compound fractures (a) six to twenty-four hours old, (b) in conditions in which it is impossible to remove all damaged tissue without gravely injuring the function of the limb, (c) in which debridement is not complete, and (d) in which there is a good deal of oozing.
- 6. Thorough drainage and Dakin's irrigation are indicated in obviously infected limbs.
- 7. Non-absorbable sutures, plates, or bands tend to promote infection.

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ACUTE LYMPHATIC LEUCEMIA*

REPORT OF CASE

Francis S. Mainzer, m.d.

CLEARFIELD, PA.

ACUTE lymphatic leucemia was first described by Hughes Bennett in 1845 and a year later (1846) by

Etiology: Recent investigations show a tendency toward the theory that infection plays a part in the production of leucemia,

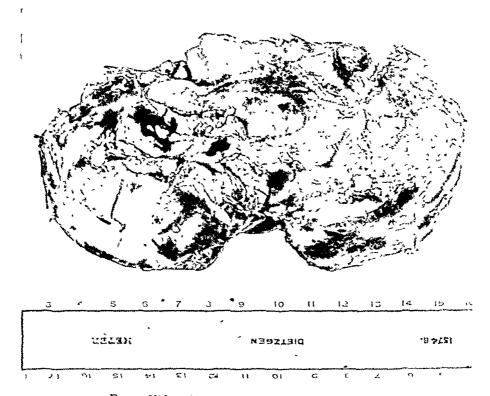


Fig. 1. Kidney in capsule, demonstrating enlargement.

Virchow. Ehrlich recognized it in 1876 and described it under two forms: (a) the splenic myelogenous, (b) lymphatic. The first was characterized by hyperplasia of the spleen and marrow elements while the second by hyperplasia of the lymphatic glands. The acute lymphatic type is a progressive fatal disease of unknown etiology characterized by a sudden onset, fever prostration and a tendency to necrotic or gangrenous processes in the mucous membranes of the mouth and throat with no marked enlargement of the spleen, liver or lymph glands.

as certain microorganisms have been reported causative, but nothing can as yet be said as definite with relation to the specific etiology of the disease.

Symptoms: The onset may be acute or gradual, with or without a chill, fever, weakness, profound prostration, sore mouth and in some cases nausea and vomiting. Anemia manifests itself early by pallor, muscular weakness, headache, vertigo and swelling of feet.

Physical signs: Loss of weight is usually marked. The glands of the axilla, groin and neck are as a rule affected.

^{*}From the Department of Surgery Clinic of S. J. Waterworth, M.D., Clearfield, Pa. Submitted for publication January 9, 1931.

Splenic enlargement is not marked early. The skin may show three types of lesions; (a) ecchymosis, (b) subcutaneous abscess,

days by the lymphocytes. The blood platelets are diminished.

Prognosis: In the acute type recovery

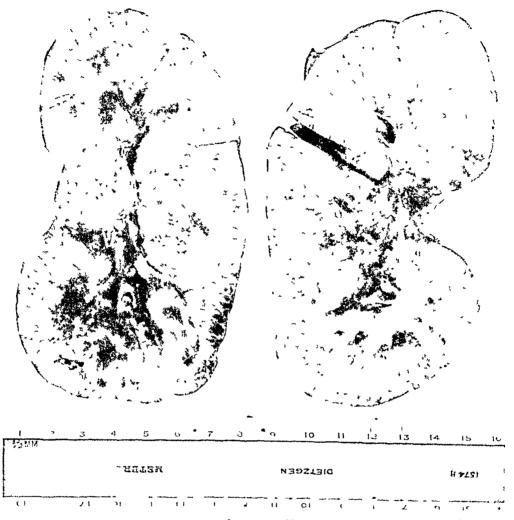


Fig. 2. Sectioned kidney showing diffuse, pale, waxy character of lymphomatous infiltration and numerous petechiae.

(c) leucemic nodules. The urine contains albumin, hyaline and granular casts and at times blood.

Blood study: Anemia is as a rule marked. The red cells vary from 700,000 to 5,000,000, while the hemoglobin ranges from 20 to 60 per cent. The distinctive pathologic increase of lymphocytes is present in a few days after the onset of attack and becomes progressively worse until the death of the patient. The white blood count varies from 10,000 to 265,000 per cubic millimeter of blood. The lymphocytes dominate and constitute from 70 to 98 per cent of the white cells. Some authors state that the polymorphonuclear count is high at the beginning, being replaced in a few

so far is unknown; it never occurs. The patient usually expires in less than three months after the onset of the disease.

Diagnosis is sometimes made with difficulty but is suggested with the acute or sudden febrile onset and the blood picture. Repeated blood examinations, enlargement of the lymph glands make the diagnosis clear.

Treatment is symptomatic. In acute cases, especially of the lymphoid type, roentgen-ray treatment is usually unavailing and sometimes has seemed to hasten the fatal termination. Animal experiment shows that the roentgen-rays have a selective action upon the leucoblastic

tissue and that under their use the lymph glands, leucoblastic marrow and spleen undergo rapid atrophy. present over the apex and aortic region, rate and rhythm good, no murmur; abdomen, walls soft, liver extends down to the umbilicus

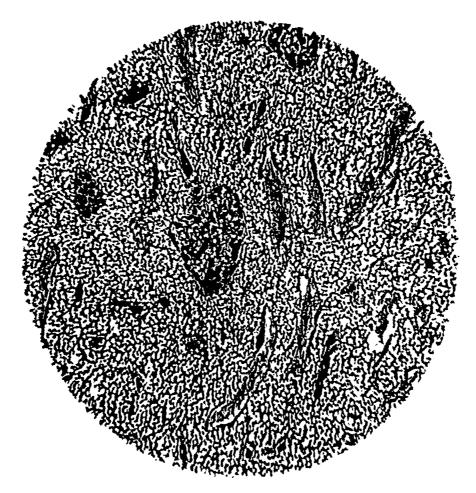


Fig. 3. Kidney, magnification X 250. Diffuse deposition of lymphoid cells well shown.

CASE REPORT

T. M., was admitted to the Clearfield Hospital June 20, 1930. The parents stated that the child was fretful and peevish, appetite was poor, slept poorly. These symptoms had been present for three months, becoming gradually worse. The child was able to be around but did not play as other children of her age.

Physical Examination: fairly well nourished female about four years of age, rather anemic. Head, scalp normal; eyes, pupils equal, react to light and accommodation; nose, septum deflected to the right; ears, no discharge, hearing good; mouth, teeth good, tongue coated, throat injected, tonsils enlarged and infected; neck, cervical glands palpable; chest, normal vesicular breath sounds are present over the entire lung areas, no râles; heart, both sounds

on the right side, spleen palpable; extremities, normal. Temperature 100°F., pulse 100, respirations 23. Blood study, hemoglobin 75 per cent, red blood cells 3,480,000, white blood cells 14,000, polymorphonuclears 72, small lymphocytes 27, large lymphocytes, platelets 120,000. Urine, specific gravity 1.020, reaction alkaline, albumin trace, microscopic, squamous cells, few epithelial cells.

The second day following her admission the parents took the child from the hospital, hence no definite diagnosis was made as study was not complete. Her second admission to the hospital was July 20, 1930 (a month later) at which time the chief complaint was fever, enlarged abdomen. The parents stated that since the child had left the hospital they noted the abdomen becoming larger and general condition worse.

Examination at this time revealed marked anemia with pallor, palpable glands of neck; heart rapid with roughening of first sound;

greater than normal. There is an unusually small amount of gas. The diaphragmatic movements are normal and equal on both sides.

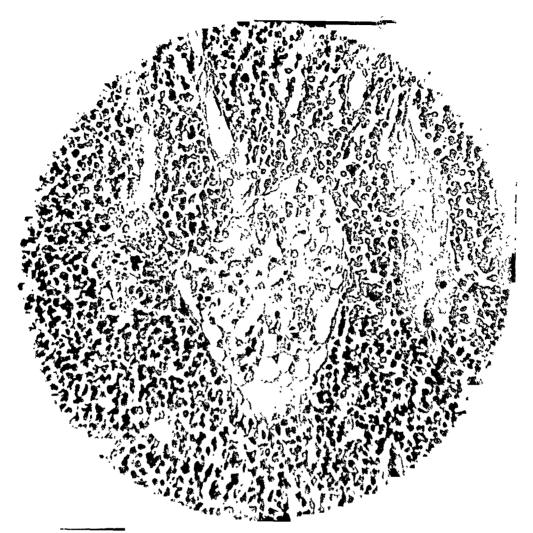


Fig. 4. Kidney, magnification × 450. Lymphoid cells may be identified as well as acute glomerular lesion, and dengenerative changes in tubular epithelium.

lungs, scattering râles over the bases of both lungs with dullness over these areas, abdomen, markedly distended, liver enlarged, large mass about the size of a grapefruit palpable in the left side. Temperature was 101°F., pulse 130, respirations 24. The blood examination showed the hemoglobin to be 20 per cent, red blood cells 1,010,000, white blood cells 88,050, polymorphonuclears 4, small lymphocytes 90, large lymphocytes 5, transitionals 1. Ureanitrogen 9.34 mg. per 100 c.c. of blood, creatinine 1.5 mg., sugar 96 mg. Feces salmon color, soft stool, negative for tuberculosis, no blood. Urine, specific gravity 1.012, reaction acid, negative for sugar, albumin negative.

Roentgen-ray of abdomen was taken with the following report: The density of the abdomen above the iliac crest seems to be much On account of the mass in the left abdomen it was decided to do a cystoscopic examination for pyelograph of left kidney which report was as follows: Catheter is coiled in a rather long slim pelvis for a child. Only the superior calyx fills. A small minor calyx is blunt as if broken off. The solution runs back into the bladder without filling the pelvis. The ureter enters the elongated pelvis at a right angle. The pelvis is undoubtedly deformed by a tumor, the outline of which is obscured by the gas-filled stomach and colon. The child was given several blood transfusions by the Unger method which increased the hemoglobin while the red cells remained the same. The white cells decreased following each transfusion. Consultation was held after which it was decided to do an exploratory operation

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as the mass on the left side was suspicious of being either sarcoma or hypernephroma. On August 1, 1930, exploration was done by Dr. white blood cells dropped to 10,500, polymorphonuclear 50 per cent, small lymphocytcs 43, large lymphocytcs 3, transitionals 2,



Fig. 5. Kidney, magnification × 450.

S. J. Waterworth with the following report: Usual incision was made for exposure of the left kidney; posterior parietal peritoneum adherent to the whole anterior surface of the kidney which stripped off readily. Dissection of the ureter and pedicle very readily accomplished. The kidney had an amyloid appearance. At no place had there been a break in the capsule. The perirenal fat appeared normal. The ureter was dissected down to the brim where it was ligated, pedicle doubly clamped and doubly ligated; the wound was closed with chromic catgut; skin closed with strips of sterile adhesive plaster. Following the operation the child had a moderate postoperative reaction but in five days the temperature was normal, pulse ranged from 80 to 90, the respirations from 20 to 23. The hemoglobin rose to 50 per cent, red blood cells to 2,300,000.

cosinophils 2.

Five days after the operation the wound was practically healed but the temperature started upward, reaching 101.2°F. two days later. The white cell count was again increasing, hence it was decided to give mercurochrome intravenously although the blood culture was normal. The patient was given three injections of mercurochrome intravenously over a course of twelve days with no improvement of temperature, while the white cell count was markedly increasing. Two weeks following operation a mass was palapable about the size of a small grapefruit in the right side which was diagnosed as an enlarged kidney. The kidney function after operation was good, urine showed a cloud of albumin with hyaline and granular casts.

The pathological report of the specimen removed at operation was as follows: "Large

firm kidney $15 \times 7 \times 6$ cm. Capsule strips easily bearing a smooth pale grayish white surface on which a few petechiae are scattered.

The patient was given three more transfusions by the Unger method. The white cell count kept increasing as did the small lympho-

NAME -	T.M.				НО	SPIT	AL -	NO. 3	38796		
									27542		
DATE	HB	R.B.C.	R.B.C. W.B.C. POLYS LYMPH LARGE TRANS EOS SPEC								
7-21-30	20	1,010,000	88,050	4	90	5	1				
7-23-30	35	1,250,000	56,800	4	91	4	1				
7-24-30	30	1,000,000	36,000	7	88	3	2				
7-25-30	30	1,000,000	22,650	15	72	10	1	2			
7-26-30	30	1,010,000	26,000	12	72	9	2	3	BASO Z		
7-29-30	35	1,020,000	27,800	15	75	7	2	_ 1			
7-30-30	35	1,020,000	26,000	10	72	12	3	3			
7-31-30	35	1,030,000	49,200	12	72	9	2	_ 3_	BASO 2		
8-1-30	35	1,360,000	36800	10	76	10	2	2			
8-2-30	40	1,300,000	33,000	7	85	4	3	ſ			
8-4-30	35	1,410,000	24,000	41	47	9	2	1			
8-7-30	55	2,310,000	13,850	50	43	3	2	1	BA50 1		
8-11-30	50	2,300,000	32,500	20	75	2	2	11			
8-13-30	50	2,350,000	58,250	5	85	7	2	l			
8-14-30	50	2,310,000	68,500	3	86	6	3	2			
8-15-30	50	2,300,000	78,350	3	96	Į					
8-16-30	50	2,310,000	77,500	5	85	7	2	1			
8-18-30	45	1,980,000	135,000	2	85	10	3				
8-19-30	45	2,000,000	153,000	1	91	7	1				
8-20-30	40	1,800,000	142,000	2	90	6	2				
8-21-30	45	1,950,000	120,000	3	91	5	1				
8-22-30	45	1,960,000	98,600	4	89	6	1				
8-23-30	50	1,990,000	98000	3	91	5	1				
8-24-30	50	1,900,000	128,000	2	91	3	4				
8-26-30	50	1,970,000	118,500	3	89	2	4	2			
8-27-30	40	1,250,000	265,000		95	3					

Fig. 6. Table of consecutive blood counts, showing remissions after nephrectomy Aug. 7, 1930 and gradual increase in leucocyte count to 265,000 before death.

Cut surface is smooth, grayish yellow with a few streaks and spots. Markings are indistinct in most pyramids. Pelvis not enlarged relative to size of kidney."

Microscopic Examination: The normal structure of the kidney is almost completely supplanted by a diffuse deposition of lymphocytes lying in a fine reticular stroma. The round cells have vesicular nuclei, in some places hyperchromatic, but no mitotic figures are seen. The remaining glomeruli and tubules are widely scattered and albuminous. Degenerative changes are marked.

Diagnosis: Diffuse lymphoma of kidney.

cytes, the latter reaching 98 per cent at one time. Five weeks after admission the patient expired.

An autopsy was performed by Dr. D. F. McClure with the following report:

External Examination: The body is that of a rather well nourished white female child of four years, of average build. The body is still warm, no rigor mortis present. Some post mortem hypostasis visible over the back. The hair of scalp is soft, brown and evenly distributed. Pupils are equally dilated. Ears and nose are normal. There is evidence of recent bleeding about the lips and gums. The skin is

pale and shows several small petechiae over the forehead and cheeks. There is a healed scar of a recent nephrectomy on the left side. There is a firm nodular enlargement of both parotids, not attached to the skin. The cervical lymph nodes are bean sized. Axillary and inguinal lymph nodes are enlarged to the size of lima beans. They are firm and discrete. The epitrochlear glands are small. The abdomen is distended. The spleen is 3 cm. below the ribs. The liver extends to the umbilicus. The lower pole of the right kidney reaches to the iliac crest.

Internal Examination. The main incision extends from 2 cm. below the suprasternal notch to the symphsis pubis. There is scant panniculus. The peritoneal cavity contains about 350 c.c. of clear straw-colored fluid. The peritoneal surfaces are clear and glistening excepting in the left lower quadrant where numerous dark red petechial hemorrhages are visible. There are fibrinous adhesions between two loops of gut in the left lower quadrant at the site of several small subserous hemorrhages. The omentum is adherent there to the appendix.

Liver: The liver extends 3 cm. below the umbilicus. The capsule is smooth. The color is finely mottled, light yellowish brown. On section several hard white areas are cut through, near the hilus. The vessels and ducts course through it unobstructed. The outline is roughly stellate.

Gall Bladder: The gall bladder is opaque-white in color. The serosa is smooth and glistening. The wall is ½ cm. thick and rather firm. In the fundus the papillae of mucosa appear enlarged. The cystic and common ducts are patent. A clear brown bile can be expressed from the papilla of Vater by pressure over the gall bladder.

Spleen: The spleen extends 3 cm. below the costal margin. It is firm in consistency. The capsule is smooth, grayish red. On section the pulp scrapes away with little difficulty. Near the hilus a firm white area is cut through, about 1 cm. in diameter. It has the appearance of growth by expansion.

Stomach: The stomach is partially distended by undigested food. The wall is soft. Numerous bean sized lymph nodes along the lesser curvature are firm and discrete. The mucosa shows a few petechiae. The jejuneum and ileum show very little change. Peyer's patches are not enlarged. Solitary follicles appear pinhead in size. Several petechiae and vibices are seen in the lower end of the cecum and at the base of the appendix. A recent blood clot is found free in the cecum. At the splenic flexure the mucosa show numerous small hemorrhages, up to 5 cm. in diameter and small pinhead sized ulcers. At the lower end of the sigmoid the wall is firm, homogeneous and white, up to 1 cm. thick, pushing the mucosa forward in the form of a broad based papilloma with hemorrhagic surface.

SEPTEMBER, 1931

Appendix: The appendix is 7 cm. long and up to 1½ in diameter at the tip. The serosa shows several petechiae. The mucosa is ½ cm. thick.

Kidneys: The left kidney is missing. There is edema and slight injection of the tissues at the site of operation. The left adrenal is surrounded by edematous connective tissue. On section the cortex appears pale yellow with practically no zone of darker brown present. The proximal end of the lower half of the left ureter is held in young scar tissue medial to iliac vessels and close to the promontory of the sacrum. The right kidney extends to the crest of the ilium and to the midline of the abdomen. The capsule strips with ease revealing a smooth, pale yellowish-gray cortex, closely speckled with dark red petechiae and vibices. On section the cortex is opaque yellowish-gray throughout with numerous parallel streaks and spots. The normal markings are not very clear cut. The pelvic epithelium appears normal. The bladder contains clear yellow urine. Mucosa appears normal except for slight redness about the urethral orifices.

Pancreas: Pancreas is quite firm and is matted with enlarged lymph nodes. All the mesenteric retroperitoneal and iliac glands are numerous, discrete and firm and up to 1½ cm. in diameter. On section many show small hemorrhagic spots and streaks, on a firm white matrix.

Thorax: The thoracic cavity, organs not removed. There is no free fluid. Pleural surfaces are smooth and glistening.

Lungs: Both lungs are soft and crepitant. A few large mediastinal nodes are felt.

Thymus: Thymus is $9 \times 5 \times .2$ cm. and extends down to the level of the third interspace.

Heart: Does not appear enlarged.

Microscopic Examination: Appendix: Mucosa and subserosa are densely infiltrated with lymphoid cells. Muscularis is only slightly involved.

Kidneys: Dense, homogeneous lymphoid infiltration of the stroma of kidneys, separates tubules and glomeruli widely. Tubular epithelium shows cloudy swelling. Here and there small interstitial hemographes are seen.

Gall Bladder: Rugae of mucosa are enlarged and filled with densely arranged lymphoid cells. Musculature is but little involved. Subserous infiltration is 6 mm. deep.

Lymph Nodes: Larger than normal. Germinal centers cannot be distinguished. A few small hemorrhages are interspersed throughout the dense lymphoid stroma.

Wall of Sigmoid: Submucosa is very deep and made up of fatty tissue surrounded by large areas of albuminous degeneration. Blood vessels are packed with lymphocytes. Lymphoid infiltration of the walls is not very marked.

Pancreas: Lymphoid infiltration follows the fibrous septa, separating the lobules. There is a moderate increase in the amount of fibrous tissue.

Spleen: Trabeculae are far apart. Sinuses contain many lymphocytes.

Microscopic Diagnosis: Diffuse lymphoma of Kidneys. Diffuse lymphoma of gall bladder. Lymphomatous infiltration of pancreas, spleen, appendix and lymph nodes. Acute lymphatic leucemia.

Clinical Diagnosis: Acute lymphatic leucemia.

Gross Anatomical Diagnosis: Acute lymphatic leukemia. Ascites. Petechial hemorrhages of mucous membranes of mouth. Petechial hemorrhages of the peritoneum. Petechial and submucous hemorrhage of the colon. Recent scar of left nephrectomy. Enlarged retroperitoneal and mesenteric lymph glands.

Diffuse lymphoma of right kidney.

Lymphomata of liver, spleen, gall bladder and pancreas.

I wish to express my thanks to Dr. S. J. Waterworth and Dr. D. F. McClure for their assistance in reporting this case.



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- * Continued from p. 564.

TUMORS OF THE KIDNEY

WITH ESPECIAL REFERENCE TO THE HYPERNEPHROMATA*

LAWRENCE W. SMITH, M.D., AND HENRY W. FERRIS, M.D.

NEW YORK

INTRODUCTION

IT is our purpose to review, as briefly as possible, the pathological classification of tumors of the kidney, with the point in mind primarily of correlating these pathological diagnoses, where possible, with differential clinical prognosis, and indicating the pathologist's function in the field of genitourinary surgery.

For this purpose we have drawn our material from the service of the Brady Urological Foundation at the New York Hospital under Dr. O. W. Lowsley's direction, and from the other surgical services of the New York Hospital. And. it is through their kindness that we are able to present the specific cases as examples of the various types of tumor under discussion. In addition we have drawn freely on the various textbooks and published papers concerning these tumors over the past ten years, including so recent a presentation as that of Perla at the November meeting of the New York Pathological Society.

EMBRYOLOGY

We will presume for the moment to recall hastily the essentials of the embry-ologic development of the kidney in order to understand our classification of its tumors, for in hardly any other single group of tumors does Cohnheim's theory of cell rests play so prominent an etiologic part.

To summarize the embryologic studies of the origin of the kidney, as expressed particularly by Bremer, it may be said that all the renal organs, pronephros, mesonephros (Wolffian body) and metanephros (mammalian kidney) are developed

from the nephrotomes. In man the pronephros normally disappears, the Wolffian body itself atrophies entirely in the female, and in the male plays a part in the development of the epididymis, while the actual renal tissue is derived from the metanephros.

However, the Wolffian duct persists for some time and each duct near the place where it enters the cloaca forms a knob-like outpocketing which elongates rapidly, becoming the ureter. This, in turn, expands, becomes lobular and produces the pelvis of the kidneys, including the major and minor calyces and the collecting tubules with all of their branches.

The second part of the kidney which consists of dense mesenchyma subdivides into masses enveloping the enlarged tips of the collecting tubules to form vesicles. These elongate, forming s-shaped tubules, whose upper, outer ends unite with the collecting tubules and whose lower ends form the glomeruli with their capsules.

The adrenal, in turn, develops in two parts in man, the cortex appearing first. It is formed from cells which develop as buds of the celomic epithelium growing into the mesenchyma on either side of the mesentery, medial to the Wolffian bodies. The medullary portion is derived from chromaffin cells of the sympathetic ganglia growing ventrally along the medial side of these masses.

From this mode of development, it is obvious that accessory suprarenal glands may occur locally, or be carried down with the descent of the gonads into the epididymis or broad ligament. It is equally obvious that normally there is very little opportunity for adrenal cell rests to occur in the kidney.

^{*} From the Department of Urology, James Buchanan Brady Foundation, New York Hospital, and from the Division of Laboratories, New York Hospital. Read before the meeting of the American Urological Association (New York Branch) Dec. 4, 1930.

Bothe,2 however, in a recent article reviewing the embryology of this region, shows, as other investigators have, that

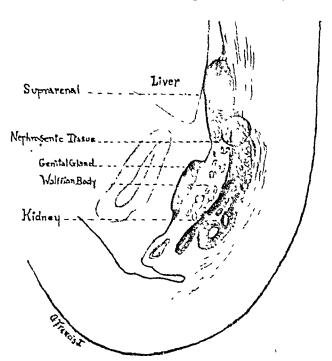


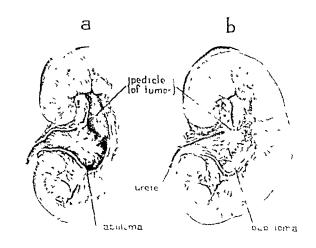
Fig. 1. Longitudinal section of a 16 mm. human embryo. (Modified after Wilson and Willis.)

in some cases there may be a time between the regressive phase of the pronephros and mesonephros when the nephrogenic tissue may lie in close proximity to the suprarenal body, and thus it is not impossible or even improbable that such adrenal rests may subsequently be found just beneath the capsule of the kidney and give rise to tumors presenting modified variations of the morphologic characteristics of adrenal cortex. This, by no means, indicates or even suggests that all tumors of the kidney cortex are adrenal in origin as many investigators would seem to believe.

CLASSIFICATION

Based on the embryologic origin recounted here of the various types of cells associated with the development of renal neoplasm, it is relatively simple to devise a workable pathological classification of these tumors. Broadly, they can be divided into two major groups: First, those in the renal pelvis, and second, those which are found in the cortex.

Pelvic Tumors: The pelvic tumors are less commonly encountered, and are well understood. There is little opportunity



Wm P Didusch 1

Fig. 2. Case No. 40635. Male sixty-two years. Papil-Ioma of bladder showing distortion of pelvis.

here for discussion. They may be said to correspond quite accurately to the epithelial tumors of the bladder, being derived as they are from the same parent tissue. They may be divided into two chief types, the papillary and the squamous, but the former tumors may lose their papillary structure and become alveolar in form. Their malignancy may be quite accurately measured by histological gradation of their cellular mutation, the papillary form being the least invasive, and having the lowest mortality rate. The squamous form, on the other hand, unlike the papilliferous tumors, tends to invade more extensively, even involving the blood vessels, and accordingly is not unlikely to be associated with distant metastases. Hunt and Hager³ reviewed a series of 271 cases of malignant renal neoplasms, and found but 23 instances of the pelvic type of tumor, a total incidence of but approximately 1 in 12. In this series of 38 cases we have 6 examples of this type of tumor which would suggest that their figure is too

In our 6 cases we have a fairly representative series ranging from an essentially benign papilloma (No. 40635) in a man of sixty-two, through instances of varying

malignancy of the transitional type of epithelium up to a typical acanthoma (No. 36797) occurring in a man of fifty. Of

stance, in places 2 cm. thick, and projecting into the hilar fat tissue. On microscopic examination, showed compactly arranged sheets of

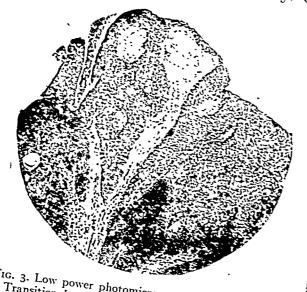


Fig. 3. Low power photomicrograph from same case. Transitional cell papillary epithelial masses, comparable to those seen in vesical tumors.

these 6 examples 3 are known to be dead, 2 have not been traced, and only I, the papillomatous case, is still known to be living. (This case was reported in detail by Dr. Kimball in the December, 1930, number of the American Journal of Surgery, and is included here through his courtesy.)

CASE HISTORY

Case I. No. 35458, J. S. a white man, forty-eight years old, was admitted to the New York Hospital, February 12, 1927, complaining of dull left lumbar pain, and sharp sticking pain near the outer border of the left rectus muscle of six weeks' duration. The latter was thought to be associated with constipation. He had never suffered any urinary disturbances. Physical examination showed only a questionable mass and tenderness in the left kidney region. The urine contained a few red blood corpuscles and clumped white blood corpuscles. X-ray. showed a possible stone in the left ureter. Cystoscopy revealed no phthalein excretion from the left kidney. Left nephrectomy was performed. The specimen consisted of a kidney 15 cm. long. The pelvis and calices were considerably distended. A large portion of the pelvic wall was occupied by a solid white sub-



Fig. 4. Case No. 36797. Male fifty-nine years. Typical acanthomatous type of squamous carcinoma of pelvis. Low power photomicrograph.

cells with apparent attempts at pearl formation with prickle cells in places. Some carcinomatous invasion of the lymph channels of the hilum was found. There was also a chronic pyelitis.

In general this group of cases is of particular interest clinically, as it is recognized relatively early through an associated hematuria, and characteristic pyelogram. Accordingly, its operative treatment is usually instituted at a favorable time, and three, five and even ten year cures are not at all infrequent in the literature.

Cortical Tumors: The cortical tumors are much more of a problem from the pathologist's standpoint, and even today we find no complete agreement as to pathogenesis. Certain names stand out in the history of their histologic study:

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Waldeyer,4 who in 1867 associated renal cancer with renal tubular epithelial changes, and Grawitz, in 1883, who first conceived

Grawitzian type of tumor histologically is in its polymorphism. Occasionally we find tumors in which the typical arrange-

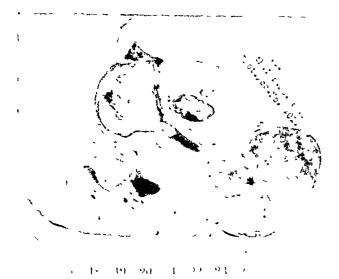


Fig. 5. Case No. 36935. A typical case of adrenal type tumor, showing involvement of pelvis.

the notion of the possible adrenal origin of the yellowish tumors of the cortex; Birch-Hirschfeld,6 who first introduced the term "hypernephroma" in 1892; Sudeck⁷ in 1893; Stoerk⁸ in 1908, and Wilson⁹ in 1911, who disputed this relationship, and Wilms, ¹⁰ in 1899, who first recognized the embryonal nature of the sarcomatous tumors of childhood. Since that time no really important contribution has been made as to their pathogenesis, and the battle rages back and forth between these two major groups of extremists. And, as in most similar circumstances, the middle path is probably nearer the truth and both renal and adrenal elements may play a part in individual cases.

From our point of view, we are inclined to lean with Young, 11 and favor a generic term, such as "nephroma," as indicating a tumor of the kidney. This is in line also with Wilson's theory that these tumors are probably neither of suprarenal gland, nor of metanephrotic origin, but more likely are derived from the nephridial blastoma, which perhaps more readily might explain their usual occurrence just beneath the capsule of the kidney proper.

The principal difficulty which has to be overcome in determining the origin of this



Fig. 6. Same case. Pyelogram showing diagnostic deformity.

ment of the cells is indistinguishable from that of adrenal cortex, and in which this structure is uniformly found throughout the tumor. For the sake of argument, we might concede an adrenal origin of this type of tumor, based solely on morphology.



Fig. -. Case No. 42408. Male fifty-three years. Gross specimen of rather large cystic, encapsulated adrenal type tumor.

Unfortunately, however, it is extremely rare to find such characteristic tumors. They are apt to be small, and more often found accidently at post mortem, than during life. Whereas, on the other hand, the usual and common kidney tumor is one in which typical adrenal appearing tissue

is admixed with areas showing definite shall we do with the occasional morphotubule formation and often papillary prolif- logically indistinguishable papillary tubieration of the cells. Some of the cells may

form tumors when we find them in the

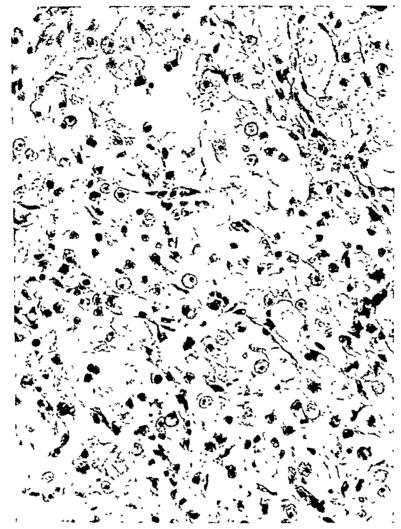


Fig. 8. High power photomicrograph of same, illustrating zona fasciculata arrangement of cells. Note also small nuclei and vacuolization of cytoplasm.

be "foamy," some "clear," while others may be distinctly "granular." Marked pleomorphism may be present. Irregularity in size and shape of cells is frequently to be noted, and it is difficult to concede a strictly adrenal "rest" origin to such a tumor.

But our difficulties do not end at that point. As Stoerk and others have suggested, the morphology of these papillary, tubiform neoplasms strongly favors a renal tubular epithelial origin, and the more generally accepted view today subscribes to this hypothesis. What then

adrenal? No one, we think, has had the temerity to even intimate that such tumors represent renal tubular epithelial "rests" in the adrenal. And so, having traversed the entire circle we come back to our starting point, what is the pathogenesis of these curious, more or less encapsulated, yellowish tumors which we find in the kidneys of middle-aged men and women?

We cannot concede, as Perla recently essays to, the Grawitzian hypothesis of all these tumors, nor can we admit the monophylistic hypothesis of renal epithelial origin, and are forced to conclude that both tissues may play a part in the pathogenesis of this group of tumors.

glitters, certainly, all more or less encapsulated yellow tumors are not of adrenal cortical "rest" origin, as for

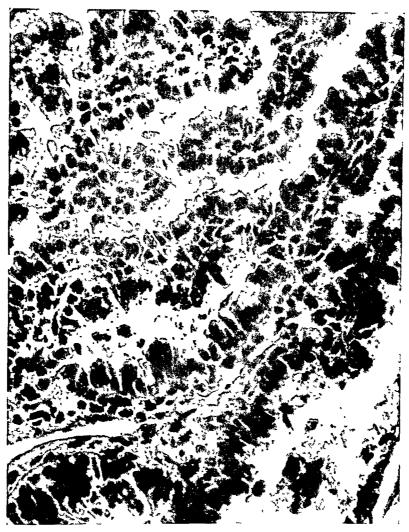


Fig. 9. High power, illustrative of granular type of papillary adenocarcinoma of kidney, quite unlike preceding case.

Dealing as we are with tissue all derived from such closely related mesothelium, Wilson's proposal to apply the term "mesothelioma" to them is perhaps as nearly accurate a plan as any. But, we feel that such a term is unsatisfactory as it does not express the very obvious differences in character of the developed tumors. It is quite possible that we may have actual tumors of adrenal rest origin, although the proof is most unsatisfactory. In the first place, the clinical evidence of virilism which is so apt to occur in true adrenal cortical tumors has not been reported so far as we are aware in a single case of renal "hypernephroma." Like the old familiar proverb, "all is not gold that

example, the curious lipoidal, vacuolated cell tumors of the thyroid or breast, certain xanthomata and the like. From the rather insecure embryologic evidence, has been built an exceedingly top heavy house of cards, which justly, we believe, has fallen to the ground. Ewing12 in his chapter on tumors of the kidney concludes that true adrenal rest tumors must be of comparatively infrequent occurrence.

And yet, we cannot dismiss the theory as entirely untenable and are inclined to feel that true adrenal tumors may occasionally occur. They present some differential features both histologically and clinically, which tend to segregate them into a definite pigeon hole. In our series we have 5 cases which might reasonably be included in this group; of which the following are representative:



Fig. 10. Case No. 41331. Male fifty-two years. Illustrative of clear cell type of papillary adenocarcinoma, presumably of renal tubular epithelial origin.

CASE II. No. 42408, V. I., a white male of fifty-three was admitted to the New York Hospital September 24, 1930. For about eleven days his urine had been dark brown in color, and during the last few days had contained fresh blood. He had also had pain in the right kidney region. Physical examination showed nothing significant. His urine contained many red blood corpuscles. The phthalein excretion from the right kidney was 0.5 per cent in five minutes. Pyelogram showed a probable tumor. Right nephrectomy was done. The upper twothirds of the kidney was occupied by an encapsulated mass 10.5 cm. in diameter. The tissue was soft, red and yellow. Microscopically, cords of foamy cells separated by delicate strands of connective tissue, were seen. The patient is alive at time of writing.

CASE III. No. 28032. W. J., a white male,

fifty-three years of age, entered the New York Hospital April 3, 1922, complaining of loss of weight and strength, "bilious" attacks, and pain in the right upper quadrant of three years' duration. A pyelogram suggested a new growth in the lower left kidney. A nephrectomy was done. At the lower pole was found a tumor 6 cm. in diameter. On section yellow with streaks of hemorrhage and pale connective tissue. Microscopic preparations showed the cords of foamy cells with small nuclei of a "Grawitz" type of neoplasm. In 1923 he again entered the hospital for a cholecystectomy. In 1926 "a tumor attached to the ilium" was found, treated by x-ray, following a course of lead therapy at St. Luke's Hospital. He finally died in the Memorial Hospital, May 4, 1927. An autopsy showed metastases to the lungs, heart, pericardium, right kidney, bones, liver and peritoneal cavity.

In general, it may be said that as a whole, these tumors tend to remain encapsulated, and accordingly are more benign. They are apt to be smaller than the typical tumor of renal origin, but unfortunately do metastasize relatively early. Throughout their natural history their morphology is likely to remain relatively constant; masses of uniformly large "foamy" cells arranged in sheets or trabeculae as in the zonae fasciculata or glomerulosa of the normal adrenal. The nuclei are typically small and eccentric, and the cytoplasm lacks the clarity or the granular appearance of the other more usual form of tumor. Furthermore, there is a rather dense central fibrous core and the cords of the cells are often arranged about vascular sinuses as in the adrenal itself. The importance of their recognition histologically is because of their possibly more favorable prognosis.

We should not be inclined to argue too strenuously with anyone who maintained that even these tumors failed to qualify as of true adrenal origin, and merely represented a more completely differentiated type of the common or garden variety of cortical tumor, a type which might be graded histologically as of comparatively low degree malignancy. The point which

Perla made in this respect is of interest. He compares these "silent" hypernephromata with the "fetal" adenomata of the thyroid which histologically remain benign save for occasional invasion of the blood stream with the establishment of distant histologically benign metastases which may be the occasion for calling attention to the primary tumor.

On the other hand we have those tumors in which we feel a definite origin from renal tubular epithelium can be traced. And yet, here too, our evidence is chiefly circumstantial for certain links in the chain are lacking. Such tumors have been especially described by Ewing.

Among the well-recognized tumors of the kidney are the tiny hyperplastic adenomata usually found in the cortex of sclerosed organs, and often multiple. Here there is general accord as to their tubular epithelial origin. But, unlike other adenomata there is no great tendency toward malignant degeneration, and the intermediate stages between benign adenoma and frank adenocarcinomata is seldom found.

Whatever their pathogenesis, these cortical renal tumors form a very definite histological and clinical group. It is to this type of tumor that the misnomer "hypernephroma" has become inseparably attached in the minds of most clinical surgeons, and the attempts of pathologic purists to replace it by a more exact terminology is probably quite futile. However, there are subdivisions within the group, and their behavior in these divisions varies within rather wide limits. Of these variations in morphology, we have two fairly clear cut types; first the comparatively rare "granular" cell papillary tumors, in which the cells are deep staining, the cytoplasm almost homogeneous, the nuclei small and deep staining and cells arranged on rather heavy fibrous stalks; and second, the most common tumor of the whole series, the typically "clear" cell papillary adenocarcinoma. In these the cells are large, coarsely vacuolated, so that

their cytoplasm is barely recognizable, except for the limiting membrane outlining it. The nuclei tend to be larger, often with

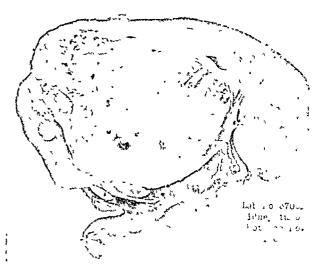


Fig. 11. Case No. 37085. Relatively small localized tumor of renal type. Shows characteristic loss of capsule.

a well defined nucleolus and definitely recognizable strands and granules of chromatin. The stroma is a delicate stalk composed of capillary vessels and a few supporting connective tissue strands. The lumina of the acini frequently contain a homogeneous pink staining colloid like material.

The tumors are apt to be extremely vascular with many areas of necrosis. They may attain considerable size, 10 to 20 cm. in diameter. They lack the characteristic central fibrous core associated with the "adrenal" type of tumor. In addition they are much less definitely encapsulated, often infiltrating irregularly not only the kidney substance, but the surrounding perirenal tissue. Like the hypernephroma they very commonly invade the renal vein, and extend along the inferior vena cava.

In our series we have 21 cases which we feel belong in this group, of which the following are representative:

Case IV. No. 41331 (6931). G. P., White male of fifty-two years, was admitted to the New York Hospital February 14, 1930 with a history of recurrent attacks of lumbar pain accompanied by hematuria. The first was five years before. He had several such attacks in 1928. Physical examination produced no significant findings. Pyclography showed a picture

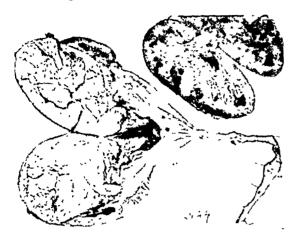


Fig. 12. Case No. 6434. Autopsy specimen from similar extensive involvement of one kidney in renal tumor.

suggesting a tumor of the right kidney. He was discharged February 17, 1930, but readmitted March 20, 1930, and a nephrectomy performed. The kidney contained a mass in its central portion, measuring $5 \times 5 \times 4.5$ cm. It was soft and reddish-yellow with white trabeculae. The growth seemed to be invading the veins. Microscopic sections showed acini and papillary structures with very clear cells lining the spaces or covering the delicate bands of stroma. Many of the acini contained clear pink staining material. There are small hemorrhages in portions of the stroma, which in places is very dense. He developed a bilateral bronchopneumonia and right empyema, and died ten days postoperative. Post-mortem examination revealed no metastases.

Case v. No. 39759. L. H. White male fiftyseven years old, entered the New York Hospital May 4, 1929, complaining of frequency, nocturia and attacks of left lumbar pain of four years' duration, and of hematuria present for one month. Physical examination showed a slightly tender mass in the left upper quadrant. Pyelogram showed a probable horseshoe kidney with stone in the left pelvis. At operation the left side of the horseshoe kidney was removed. An encapsulated soft tumor, 5 cm. in diameter was found at the lower pole. Section showed a yellow surface streaked with red. A large stone was present in the upper part of the kidney associated with pyelonephrosis. Microscopically the tumor was composed of rather solidly arranged clear cells, but with definite papillary

and acinar arrangement in portions. The patient was still living in March, 1930. This case is recorded through the courtesy of Dr.



Fig. 13. Case No. 39759. Male fifty-seven years. Case of Dr. DeVries. Horseshoe kidney, showing tumor in lower pole and nephrolithiasis in upper pelvis.

John de Vries, the attending urologist. It is particularly of interest because of its occurrence in a horseshoe kidney and its association with stone.

Including the 5 possible adrenal tumors, the statistical study of these 26 cases may be briefly summarized The average age. was 55.7 years, the extremes being a young woman twenty-seven, and a man seventy-seven years of age. There were 18 males and 8 females. The right side was involved thirteen times, the left thirteen times. The tumor was in the upper half of the kidney ten times, in the lower half eleven times. In the remaining 5 cases the location was either not stated or the tumor was described as being in the midregion. Stone was found twice in association with pyelonephritis and the tumor.

Nephrectomy was performed in 24 of the 26 patients. The other 2 cases were found incidently at autopsy. Five of the patients are still living, 11 have died, and the remaining 10 have not been traced completely. Four of them, however, were alive two to three years postoperatively.

Clinically, the presenting symptoms were: pain, which occurred in 24 of the cases; hematuria, which was present in 15 instances, and the presence of a subjectively recognized tumor in 6 of the cases. The duration of symptoms varied greatly, the extremes being eight days and seventeen years. The usual story was a matter of several weeks or months. The diagnosis was confirmed in most instances by pyelography and operative measures carried out as indicated.

In addition to the 26 cases cited here are 6 others in which the data are incomplete, but in which there is little doubt as to the diagnosis, and which we feel could be included in this group of renal carcinomas.

EMBRYOMA

Finally, there is the important group of tumors occurring almost entirely in the first decade of life, the embryonal tumors of Wilms, often spoken of as sarcoma, adenosarcoma, adenomyosarcoma, or mixed tumors of the kidney. Wilms' original conception of these tumors required the inclusion of nephrotome, sclerotome and myotome to account for the wide variation in the histology of the developed tumors. Muus¹³ accredits the origin simply to the renal blastoma, as do Wilson, Glynn, 14 Young and others, who feel that this mesothelium is fully capable of differentiation into the various elements of the tumors. The difficult feature to account for is the frequent presence of smooth or striated muscle and many investigators are in accord with Wilms' original theory that at least myotome inclusions must be present. Ribbert15 even goes so far as to believe that they are true teratoid tumors and must be derived from aberrant sex cells. Again, their pathogenesis is a matter of academic dispute and of little practical importance. Their recognition clinically is comparatively simple. Their occurrence in infants and their relatively and actually enormous size, some of them attaining a diameter of as much as 35 cm. is very suggestive. Their gross appearance is also characteristic. They tend to be solid, opaque,

whitish tumors, well encapsulated, and infrequently showing metastasis. As they increase in size they become cystic and

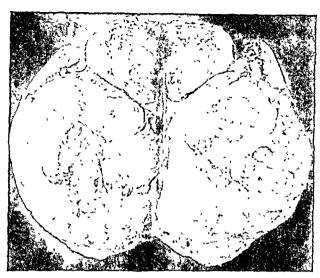


Fig. 14. Case No. 18376. Kidney from infant of three months, showing extensive replacement of renal tissue of embryonal tumors. Wilms' embryoma.

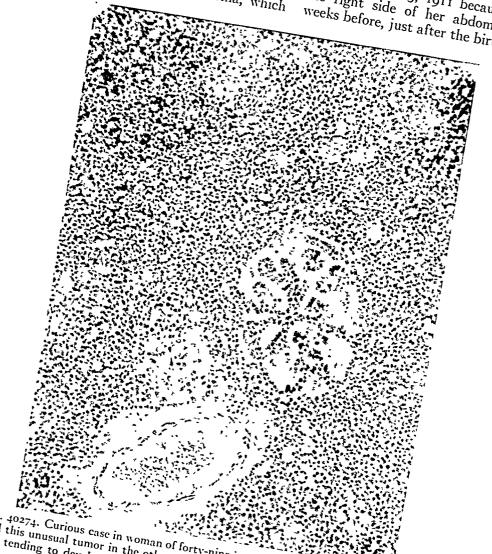
less easily identified, especially when found in adults.

Among these tumors may be cited a rather well-defined group of cases designated as embryonal adenocarcinomata and occurring usually in young adults. We are inclined to feel that they are merely a curious one-sided, late development of this same general type of embryomata. The following are representative histories:

CASE VI. 18376 T. J. Male, aged two and one-half years, was brought to the New York Hospital June 10, 1915. Eight months before his father had noticed a firm, hard lump in the lower part of the child's abdomen. This mass increased in size, and the child lost some weight. Physical examination showed this mass to be about 6 in. long, in the left kidney region, and freely movable. The urine showed no red blood cells. A left nephrectomy was performed. The specimen presented a new growth about the size of a cocoanut, irregularly ovoid, and occupying a position between the two poles of the kidney. A thin layer of parenchyma connected these poles. The tumor seemed to be in two parts. The general color of the larger part was greyish yellow, with portions resembling brain tissue. The smaller portion,

which was hemorrhagic, encroached on the pelvis. Microscopic sections showed a relatively loose, but fairly cellular stroma, which

Hospital July 13, 1911 because of a lump in SEPTEMBER, 1931 the right side of her abdomen, noticed ten weeks before, just after the birth of her young-



at one pole and this unusual tumor in the other pole Shows what we interpret as a relatively undifferentiated at one pole and this unusual tumor in the other pole. Shows what we interpret as a relatively undifferentiated in places suggested smooth muscle strands.

Masses of dark staining more rounded cells were scattered here and there and throughout were found small tubular structures lined by cuboidal cells, with dark nuclei. The postoperative course was complicated by measles. He had two subsequent admissions for recurrence of the mass in his abdomen, with evidence of free fluid. He became weaker, and died December 29, 1915. Autopsy was not

CISE VII. No. 14235. A. S. A white female thirty-four years old, entered the New York

est child. The lump increased gradually in size, and she also suffered some obscure rightsided pain. She had grown thinner. Physical examination revealed malnutrition and some anemia. The abdominal mass, the size of a cocoanut, extended up into the right hypochondrium, and seemed attached to the kidney, or under surface of the liver. It could be moved from side to side, but not up and down. The urine contained no red blood corpuscles. An exploratory laparotomy was done and a tumor extending up under the liver found. Two pieces of tissue removed from the anterior surface showed microscopically renal tiscus.

After a rest in the country, she entered the hospital again September 8, 1911, when right nephrectomy was performed. The removed

and tubular formation. They usually contain muscle fibers of the striated or smooth type. Typically their stroma presents a



Fig. 16. Typical mixed tumor of kidney showing tubular structure amid a sarcomatous stroma.

specimen was about 24 × 14 × 8 cm. The kidney was flattened out on one surface of this mass, but seemed to fuse with the growth, which was irregularly lobulated, soft, yellowish. Microscopically the tumor showed a picture much like that seen in case No. 18376, with mixed sarcomatous and carcinomatous appearance. In 1926 she was reported to be alive, but under care of a physician for abdominal trouble.

Microscopically the tumors vary greatly, some of them being almost uniformly composed of undifferentiated renal blastemal cells, others showing pseudoglomerular

sarcomatous degeneration. They have a curious tendency to be bilateral and accordingly fatal, but when unilateral, they may be relatively benign clinically, and a few permanent cures have been recorded.

In our series we have 6 cases which fall into this group, one of them occurring in an adult, the others all in infants or young children. They range from an almost undifferentiated blastoma to completely differentiated adenomyosarcoma. Four of these patients died within one year postoperatively. One patient was still living

fifteen years later, and one has not been traced.

In addition to these relatively frequently encountered tumors there have been described many others of no significance in a discussion of this sort: lipoma, myxoma, chondroma, fibroma, etc. Among these may be cited the curious tumor described by Warren¹⁶ of a myeloid replacement of the renal pelvis.

Of the metastatic tumors the ones of particular interest are the paraganglioma and neuroblastoma of adrenal medullary origin. In some instances these tumors may appear primary and simulate hypernephromata, but careful study will usually reveal their true adrenal source. One such case was encountered in our studies, but not included in the series. Usually their identification is not difficult. They are invariably fatal by the time renal involvement has taken place.

SUMMARY

We have attempted to review briefly the more important primary tumors of the kidney and arrange them in a somewhat arbitrary classification for purposes of discussion.

In the first group we have the varying forms of papillary and squamous epithelial origin. Their malignancy can be quite accurately estimated histologically and a reasonably intelligent prognosis made.

In the second group, composed of the vast majority of the cortical tumors of individuals past middle life, we are inclined to accept the conventional classification of two major types: one, arising from adrenal rests; the other being derived from renal epithelium. Of this first type, there are but very few unquestionable examples. Of the second type we have several arbitrary subdivisions; chiefly the papillary, composed either of clear cells or of granular cells, and the rarer alveolar carcinoma.

We are inclined to feel that these tumors all have a common origin, probably from some prenephric rest, and that the differences are inherently due to the particular reaction of the individual rather than to any fundamental difference in the cells of origin.

It is not important clinically to know whether a tumor arises from displaced celomic lining cells, or from nephridial rests, except as its clinical behavior varies. In these tumors no inherent differences are apparent in their clinical course except in degree. Tumors of presumable adrenal origin are apt to be slower growing, but may metastasize by the blood stream very early. They perhaps represent slightly more differentiated epithelium than do the tumors of renal origin, but their fundamental cell prototypes are essentially the same, which brings us to the conclusion that Wilson reached twenty years ago, of the underlying mesothelial origin of the entire group.

Finally, in reviewing the embryonal tumors of infancy and childhood, we are in accord with the current theory that they are of renal blastema origin. We feel that the evidence is sufficient to show that these cells are capable of differentiation even into the bizarre and curious, almost teratoid tumors which we occasionally find. It is but a step from accepting the conception of the origin of the embryonal tumors to recognizing that the adult hypernephroma may well arise merely from a later stage of differentiation of the renal blastema. Certain of the tumors we see most assuredly support such an hypothesis. We are inclined to leave the whole problem at this point, merely indicating the present trend of thought, until some keen observer comes along and finds an entirely new method of approach to our understanding of neoplasms in general, and of these inexplicable tumors of the kidney in particular.

[For References see p. 551.]



RESECTION OF THE KIDNEY

REPORT OF SIX CASES*

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Brooklyn, n. y.

ESECTION of the kidney has been practiced by various operators at occasional intervals for many years. As a result of improved technique and more intensive efforts at conservation in all forms of renal surgery, it is coming to be more and more commonly employed. Obviously the operation is best adapted to pathological lesions associated with congenital anomalies, such for example as horseshoe kidneys, bifid pelves, etc. It has, however, a place in some cases not associated with congenital anomalies such as benign tumors, solitary cysts and calculous pyonephrosis involving one pole of an otherwise fairly good kidney.

While it is conceivable that certain cases of tuberculous or malignant neoplasm located in one-half of a horseshoe kidney might be considered as suitable cases for resection, (I am not familiar with any such cases in the literature) such lesions would in most instances preclude such an operation. Resection should never be employed for malignant tumors or tuberculosis in any kidney not the seat of a congenital malformation. The special dangers incidental to the operation are of course, hemorrhage, primary or secondary, infection and persistent urinary fistulae. Hemorrhage and infection should be easily taken care of by means of proper suturing and adequate drainage. The suture-line should be covered with fat pads and the kidney pelvis should be drained through the cortex by means of a rubber tube. Urinary fistulae may persist for a while but I believe they all close eventually. Because of the danger of infection and persistent fistulae, these cases should be approached, if possible, by the extraperitoneal route. In some cases, such as the solitary pelvic kidney, it may be necessary to go through the peritoneal cavity.

Our group of 6 cases consisted of 1 solitary pelvic kidney, 2 horseshoe kidneys, 2 large solitary cysts and 1 case of calculous

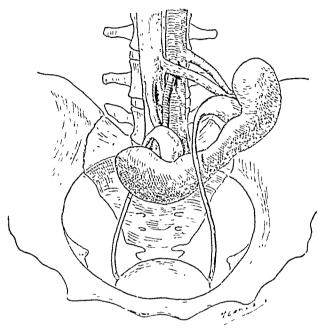


Fig. 1. Conditions found in Case 1.

pyonephrosis occurring in a bifid kidney. There was I death, the pelvic kidney, from pneumonia on the fourteenth day after operation. In I other case, horseshoe kidney, a urinary fistula persisted for nine months followed by complete recovery. The other patients made uneventful recoveries.

Following is an outline history of our cases; positive findings only are noted.

Case I. M. W., female, aged fifty, married, no children, no pregnancies, menstruation established 'at sixteen, menopause at forty. Menses had always been regular but associated with severe cramps. For past ten years has suffered from severe lower abdominal cramps and bearing down sensation. For past year these pains have recurred at more frequent intervals and are terrific in character. During this time there has been a little frequency of urination and on two occasions the patient states that there was a little blood in the urine.

Examination: Hemoglobin 37 per cent.

BLOOD CHEMISTRY

Urea		27.18
Creatinine		1.75
Sugar		166
Co2 combining power.	 	63
Wassermann test negat		

Pelvic Examination: the uterus is normal in size and position and is movable. Behind the uterus, deep in the pelvis, there is a large fixed mass very tender to pressure.

Cystoscopy: the bladder is moderately trabeculated, otherwise normal, the ureter orifices are normal and in normal position. No. 5 catheters pass readily 6 in. on right, 7 in. on left. Clear urine flows in normal rhythm from each side. Phenolsulphonphthalein output normal on left, slightly reduced on right. All specimens of urine are sterile and show no abnormal ingredients except an occasional hyalin cast. Urea content right 2.77, left 10.08.

X-Ray Report: no right kidney shadows noted, very large low left kidney, both catheters pass to left, the left catheter very much to left. Unfortunately these pictures were destroyed and are not available. X-ray diagnosis, "Solitary pelvic kidney or horseshoe kidney."

Operation, January 14, 1921: 6 in. right rectus incision. A very large solitary kidney was readily palpated, extending from above the crest of the left ilium deep down into the hollow of the sacrum. Figure I shows diagrammatically the condition noted. The cecum and ascending colon were mobilized, the pelvic portion of the kidney exposed and rather easily resected. A wedge-shaped incision was carried into the upper half of the kidney and the incision closed with mattress sutures and a free fat transplant over the suture-line. This effectively controlled all bleeding. The abdominal wall was closed in layers with a cigarette drain at the lower angle. The operation consumed one hour and the patient left the table in good condition. There was considerable abdominal distension for a few days, readily controlled by the usual measures and on the seventh day she appeared to be progressing smoothly except for a wound infection. On the night of the seventh day the wound burst open throughout its entire length and several coils of small intestine were extruded into the dressing. She was given morphine and immediately brought to the operating room, where under gas anesthesia the bowel was replaced and the wound resutured. She took her anesthetic badly and the operation was extremely difficult, requiring one hour and fifteen minutes of anesthesia. The following day she had an extensive bronchopneumonia and died six days later, fourteen days after her first operation. I have always had a feeling that a spinal anesthesia for the second operation might have saved the day.

CASE II. T. P., single, male, aged twenty-six, for past two years has had urethral discharge and cloudy urine, was treated in another clinic for several months a year ago with urethral injections and irrigations. For the past two years occasional dull ache referred to left flank.

Examination: left kidney palpable, enlarged and tender.

BLOOD CHEMISTRY

Urea										25.4
Creatini				,						1.50
Sugar.	٠.		,							100

Cystoscopy, Sept. 12, 1923: Extensive diffuse cystitis, ureter orifices normal and normally situated. No. 5 catheters pass easily to each kidney pelvis. Clear urine flows in normal rhythm from right side. Cloudy urine in a steady drip from left side. Phenolsulphonphthalein normal for right, no dye from left. A left pyclogram was made. X-ray findings, low right kidney, left kidney large with a marked hydronephrosis (Fig. 2).

Operation, Sept. 24, 1924: 7 in. oblique loin incision. The kidney is apparently converted into a sac, difficult to mobilize, particularly at lower pole. After considerable floundering around it finally became evident that the sac was continuous with normal appearing kidney tissue extending across the vertebral column and the diagnosis was obvious. There was no definite line of demarcation between the two halves of the kidney. Resection was performed, carrying the incision in a deep wedge into healthy tissue and opening into a healthy calvy.

The kidney wound was closed with mattress sutures with a free fat transplant over line of incision. No drain was placed in the kidney stump. This was an error. The patient had rather a stormy convalescence, complicated by an extensive Welch bacillus infection. This was combated by opening the loin wound throughout its entire extent, Carrel-Dakins dressings and perfingens serum intravenously.



Fig. 2. Left pyelogram showing practically complete Fig. 3. Right pyelogram, same patient as in Fig. 2 showing right half of horseshoe kidney.



Fig. 4. Left pyclogram showing practically complete destruction of kidney. Suggestive of horseshoe kidney.

On Oct. 6, 1923 a pyelogram was made of the right side (Fig. 3). This is a typical horseshoe kidney pyelogram and had it been made

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Fig. 6. Kidney removed from patient shown in Figs. 4 and 5, showing much dilated pelvis and parenchymal band forming union with other half of kidney.

before operation would have completed our diagnosis and saved us some anxious minutes during the operation. The patient was discharged from the hospital on Nov. 2, 1923 with a small sinus still draining considerable urine. This sinus persisted for nine months when it finally closed and the patient has remained well to date.

CASE III. R. C., female, aged twenty, single, for past year frequency of urination, on two or three occasions a little blood in urine, for past four days rather severe pain in left loin.

Examination: left kidney palpable, enlarged and very tender, some rigidity of lumbar muscles. Temperature normal, white blood corpuscles 15,600, polymorphonuclears 82 per cent.

BLOOD CHEMISTRY

Urea	47	5
Creatinine	2	13
Sugar	129	
CO2combining power	59	

Cystoscopy: Oct. 6, 1927, mild diffuse cystitis, ureter orifices normal and in normal location. No. 5 catheters pass readily to each kidney pelvis. Clear urine in normal rhythm from right kidney, cloudy urine in slow steady drip from left kidney. Phenolsulphonphthalein right kidney normal, no dye from left kidney, urine from right kidney free from pus and sterile. Urine from left kidney shows many pus cells and culture shows colon bacilli. A pyelogram was made of the left kidney. X-ray report: both kidneys appear low, left kidney large, outline of lower pole not made out. Pyelogram shows a marked degree of hydronephrosis. Diagnosis, left hydronephrosis (Fig. 4). On Oct. 11, 1927 a pyelogram of the right kidney (Fig. 5). This showed the typical picture of a horseshoe kidney and confirmed the diagnosis.

Operation: Oct. 14, 1927, 6 in. left loin incision, the kidney was readily exposed and was fairly easy to mobilize except at lower pole which was attached to a broad band partly fibrous and partly parenchymal, which extended across the vertebral column. This band was clamped with a heavy clamp, divided, and the kidney removed (Fig. 6). Several suture ligatures of chromic gut were applied to the stump and the loin wound closed in layers with a raffia drain at the dependent angle. There was very little urinary leakage; the patient made an uneventful recovery and was discharged to her home on the fifteenth day.

Case IV. V. D., female, married, aged fifty-seven. A few days ago rather severe pain in right loin followed by frequency and dysuria, which has persisted. Patient states that at one occasion she noted a little blood in urine. Four months ago she had a similar pain in left loin which persisted for two months.

Examination, right kidney palpable, much enlarged and slightly tender.

BLOOD CHEMISTRY

Urea		38	7
Creatinine		I	85
Sugar		104	ı

Cystoscopy, Dec. 17, 1924: Bladder and ureter orifices were normal and No. 5 catheters passed easily to each kidney pelvis. Clear urine flowed in normal rhythm from each side. Phenolsulphonphthalein was normal and equal on the two sides, urine from the right kidney was free from pus and sterile. Urine from the left kidney showed a few pus cells and was also sterile. A pyelogram was made of the right kidney.

Examination: The right kidney is enlarged and tender. Hemoglobin 66, white blood corpuscles, 8800, polymorphonuclears 66 per cent.

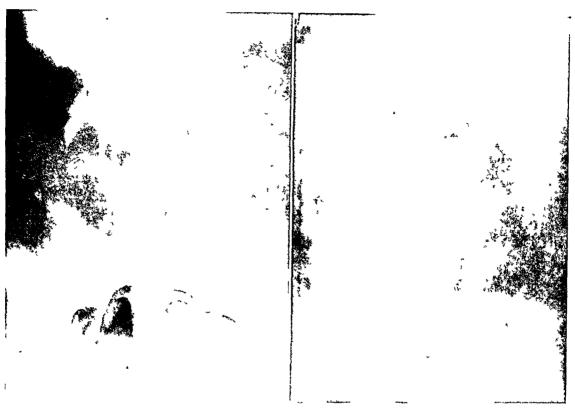


Fig. 7. Right pyelogram showing filling defect of upper cally caused by pressure of cyst.

Fig. 8. Rather faintly showing tumor mass connected and continuous with lower pole of left kidney.

X-ray report, the lower pole of the right kidney is much enlarged, the pelvis is small and the lower calyx is distorted. Diagnosis: Renal tumor (Fig. 7).

Operation: Dec. 19, 1924, 7 in. right loin incision. There was a cyst the size of a grapefruit springing from and partially including lower pole of right. This was excised, together with a wedge-shaped segment of kidney tissue. The kidney wound was closed, with mattress sutures and a free fat transplant over line of incision. Neither the kidney pelvis nor calyx was invaded and no drain was placed in kidney. The patient made an uneventful recovery. She reported again four years later complaining of some pain in left loin and moderate frequency of urination. Examination essentially negative except for delayed emptying time of left kidney pelvis. She reported that she felt better after the cystoscopy and has not reported since.

CASE v. B. C., female, married, aged fifty-five. Chief complaint pain in right loin for two years.

BLOOD CHEMISTRY
Urea 37 I
Creatinine 2 63
Sugar 116

Cystoscopy, May 14, 1926. Bladder normal, ureter orifices normal, No. 5 catheters pass readily to each kidney pelvis. Phenolsulphonphthalein a little below normal on each side. Urine from left kidney is normal, urine from right kidney shows a few pus cells and colon bacillus on culture. A pyelogram was made on the right side.

X-ray findings: the right kidney is much enlarged, the enlargement involving principally the upper pole, the upper calyx is partially obliterated (Fig. 7).

Diagnosis: Renal tumor. Pyelogram of the left kidney was normal and radiographs of the bony skeleton failed to show any metastases.

Operation, May 21, 1926, 6 in. loin incision. There was a cyst the size of large orange involving upper pole of kidney. The whole kidney, including the cyst, was placed high up under the ribs and was extremely difficult to mobilize.

During the operation an accidental tear was made in the pleura, which was repaired with sutures and a free fat transplant. An elastic

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Fig. 9. Calculus in lower pelvis of left kidney. Both ureters and both pelvis are reduplicated.

band was placed around vascular pedicle for temporary hemostasis and the cyst excised as in the previous case. This patient also made an uneventful recovery.

CASE VI. B. O., female, single, aged

thirty-six. For the past three years she has had a dull intermittent ache in right loin, pus in the urine and moderate frequency of urination. She was cystoscoped at several intervals over a period of two years, was advised on several occasions to have an operation but postponed it from time to time. She had a mild general diffuse cystitis. She had a complete reduplication of both ureters and a double pelvis on each side. In the lower pelvis of the right kidney there was a fairly large discrete calculus and this pelvis was considerably dilated (Fig. 9). The urine from this pelvis contained pus and colon bacilli. The urines from the other pelves were normal. Her blood chemistry phenolsulphonphthalein output were normal.

Operation: July 11, 1930. The right kidney was readily exposed and delivered through a 6 in. loin incision. The calculus was removed through a posterior pyelotomy. Passing a finger into the pelvis it was noted that the corresponding cortex was very thin and resection was decided upon. While there was no line of demarcation between the two halves of the kidney, it was easy to isolate a separate blood supply. The vessels and the ureter were ligated separately and the lower half of the kidney resected, using a wedge-shaped incision carried into the healthy kidney but not invading the pelvis or any of the calices. The incision in the kidney was repaired with mattress sutures of plain gut and a free fat transplant over the suture-line. She made an uneventful recovery, except for an intermittent urinary fistula, which persisted for ten weeks, when it closed permanently.



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*Continued from p. 467.

A PROSTATE PACK FOR CONTROLLING HEMORRHAGE

FOLLOWING PROSTATECTOMY*

HAROLD L. Foss, M.D., F.A.C.S.

DANVILLE, PA.

THE control of hemorrhage following prostatectomy, whether the operation is performed by the perineal

on the Pilcher bag. In 1923 I described an accordion plaited pack which was a modification of others which had been similarly



Fig. 1. Removing tags of capsule of prostate after enucleation.

or suprapubic route, has always been one of the important and, frequently, difficult problems of the procedure. With good exposure it is not difficult of solution and there are many methods used to control the bleeding, most of which are usually successful. The Hagner and Pilcher bags are favored by many and they usually satisfactorily control the oozing from the prostatic bed. Some surgeons prefer to use a small gauze pack which is but loosely applied but which, unfortunately, usually floats out into the bladder as it fills with urine, rendering the hemostasis ineffectual. Some surgeons, performing the suprapubic operation, never resort to bags or packs, relying on carefully placed sutures.

In the past fifteen years I have tried nearly every method that has been at all popular and for some years relied entirely

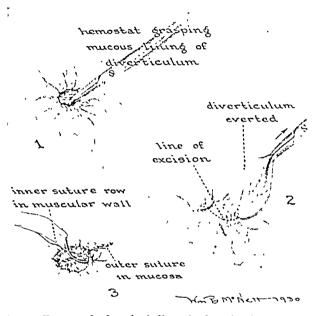


Fig. 2. Removal of vesical diverticulum in three stages.

designed and which I have found more satisfactory than any other means of controlling bleeding following the usual suprapubic prostatectomy. A few months ago I modified this pack somewhat and now, in its perfected state, it is proving so satisfactory that I felt it was worth while to again bring it to the attention of the profession. Its construction and application will be readily understood from the accompanying drawings.

With good exposure, and this does not necessarily mean a large bladder incision but one the margins of which are well retracted by means of properly designed bladder retractors, the prostate is enucleated and its bed carefully inspected. Redundant tissue or small adenomata which otherwise might be overlooked are carefully removed as illustrated in Figure 1.

The bladder is carefully examined for

calculi which are removed and for diverticula, so frequently present, which are excised according to the technique illus-

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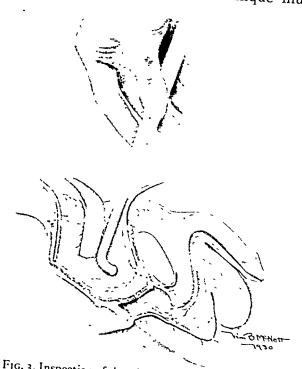


Fig. 3. Inspection of site of prostate with Cameron light.

trated in Figure 2. The bladder is then finally inspected under the brilliant illumination of a Cameron or similar light as shown in Figure 3. An occasional mattress stitch is placed in the margin of the prostatic bed if there is arterial bleeding although this is rarely necessary. The pack used is illustrated in Figure 4. It is made up in three sizes, No. 1, No. 2, and No. 3 for prostatic cavities of different sizes, No. 1 and No. 2 being the ones most frequently used. The dimensions are:

No.
$$1-26$$
 in. $\times 21\frac{1}{2}$ in.
No. $2-36$ in. $\times 3$ in.
No. $3-42$ in. $\times 31\frac{1}{2}$ in.

The pack is made of eight thicknesses of gauze folded back and forth as illustrated and through which a strong tape, similar to umbilical tape, is passed and permitted to thread. One extremity of the pack is sewed tightly with silk to the tape, the other end and the intervening plaits being permitted to slip freely as the pack is drawn together and compressed. In cutting

the eight lengths of gauze they are tapered slightly from the middle towards both ends of the piece which gives the completed

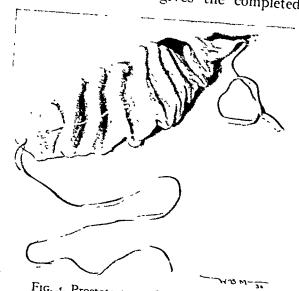


Fig. 4. Prostatectomy, hemostatic pack.

pack pointed extremities, thereby greatly facilitating its introduction and, especially, its subsequent removal. The pack is applied through the suprapubic wound and the tape pulled tightly through the urethra so that the pack ultimately fits snugly within the prostatic capsule where it is kept firmly in place by means of steady traction made upon the tape. The pack readily unfolds and is easily removed through the small wound which is left for the suprapubic tube at the operation.

Figure 5 illustrates the method of introducing the pack. An ordinary steel urethral sound, through the end of which a slot has been cut, is used in withdrawing it.

Figure 6 illustrates the insertion of the pack. As traction is made on the tape by an assistant the surgeon, using a pair of long dressing forceps, carefully adjusts the folds of the pack following which all bleeding is permanently controlled.

Figure - shows a tripod, similar to the one used by many surgeons in supporting the Pilcher bag, placed in contact with the patient's perineum and groins and utilized to maintain firm traction upon the tape and pack. The tape is held in position at the apex of the tripod by means of a hemostat. The other end of the tape is

left lying upon the abdomen, having been brought out through the suprapubic wound. In thirty-six hours the hemostat

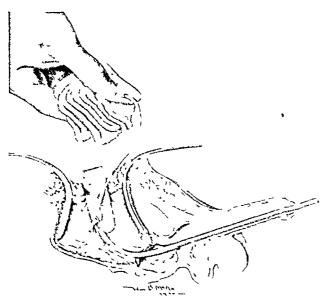


Fig. 5. Sound introduced and tape passed through slotted end.

is removed and tension on the pack released. In forty-eight hours the urethral portion of the tape is cut and the suprapubic portion drawn upon and the pack entirely removed as shown in Figure 8.

Following its removal together with the

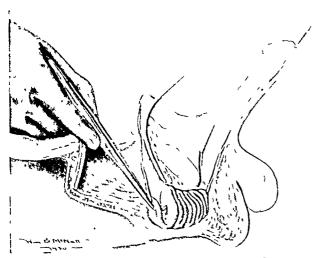


Fig. 6. Introduction of prostatic pack.

suprapubic tube, a retention catheter is passed and the suprapubic wound permitted to close. Whether or not irrigations are begun will depend on individual taste. Many, Cecil among them, object to it. However, we feel it to be an advantage, using weak solution of mercurochrome

daily and changing the catheter every third day. With this technique postoperative hemorrhage cannot possibly occur

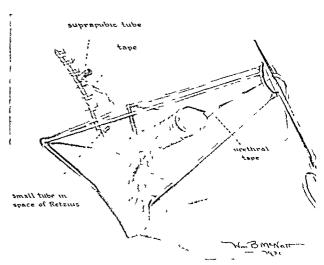


Fig. 7. Urethral tape secured by hemostat.

and the suprapubic sinuses will close as promptly as by any method yet devised. We formerly used various types of vacuum devices for keeping the bladder dry, only to discard them and to rely entirely on gravity through the indwelling catheter.

The pack was formerly made of plain surgical gauze but of late we have used iodoform gauze, it being fully as satis-

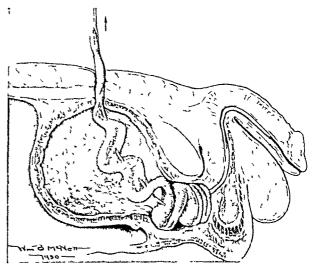


Fig. 8. Removal of prostatic pack.

factory as a hemostatic agent, while we feel that its antiseptic qualities are a distinct advantage. In our last 67 consecutive prostatectomies this pack has been used and in no instance has there been the slightest hemorrhage.

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, E D I T O R I A L ,

MATERNAL MORTALITY

ORTALITY from childbirth still excites the interest of the entire civilized world. Its morbidity we can but guess at, although we know it is formidable. It is possible however to compare parturition mortality in the United States with the death rate from the same cause in other countries of the world. Although there has been much dispute over the correctness of the figures, and the justice of various conclusions which may be drawn, the United States suffers by comparison. There is no doubt about that.

In Great Britain, Mr. Arthur Grenwood, Minister of Health, is astonished to discover that although infant mortality, and the general death rate are reduced, no progress whatever is being made in the reduction of maternal mortality. Now we are told that recent figures make us look worse, possibly the worst in the world. For this an increased incidence of puerperal infection is responsible. To say that we should pause and take stock is trite. For a long time we have been concerned, without any apparent success, in the solution of the problem.

If labor is becoming less and less a physiological phenomenon, as DeLee has so long contended, social, economic or other factors in our environment must play their part. The medical profession as a cross section of our people, have been as much affected by their environment as their patients.

While, for some years, our attention has been directed to betterment of antenatal care, and properly so, yet this has not

resulted in any appreciable improvement in the gross figures. Like the periodic health examination, even good prenatal care may be overstressed. Good obstetrics during the time of parturition is by far the most important single factor in the problem. How to procure this? The answer seems simple. Better and more nearly perfect medical education. The recent New York Hospital-Cornell Medical College Association, with its absorption of the Lying-In Hospital, and the development of a great woman's clinic modeled on the lines of the German University Frauenclinics, and backed by great funds for research, hopes to solve the problem this way. But it can not.

Only when post-graduate education of the practicing physician becomes continuous will real progress be made. Not that he must take courses in post-graduate schools. He will not. Nor are there any schools equipped to give him what he needs. Lectures, journals and reams of written advice fail to do anything more than educate specialists and the serious minded who are striving to improve themselves. The everyday doctor must be in everyday contact with good obstetrical skill and judgment. He must be able to get proper help when he needs it. He has been left to his own resources long enough. He should grow in experience and judgment, not by his own efforts, only a few can, or at the expense of his patients, but supported by consultation or help when the actual obstetrical emergency arises. Weedy, natural growth, stimulated by

expediency and necessity, should respond to careful direction.

Great hospitals, particularly in urban centers of population, should not be content to stand by while puerperal mortality takes its yearly toll. Much of that is preventable. Proprietary hospitals, like a mushroom growth, have sprung up all about them. Often with little or no supervision from city or state, they steadily increase in number and influence, and admit an ever increasing number of women for delivery.

Their great neighbor usually does excellent obstetrics, but its staff is closed. And it should be, but not for obstetrics. Long the specialty of the general practitioner, the bulk of the work will probably always be done by him. Let his patients come to real hospitals for delivery by their own doctors, who as a rule will conduct themselves properly, and be bound by any protective regulation the hospital may make, such as compulsory attendence at the staff conference, or consultation when needed. Their sense of responsibility will grow keener, and the patients' troubles grow less with increasing contacts with the form and substance of good obstetrics: Hospital bed capacity must increase with the demand, but average hospital cost will decrease, and the hospital will finally fulfill one of its finest functions, and play a great part in the solution of this most important problem. Nowhere but in continuous effort to bring education to the general practitioner, will the answer ever be found.

CHARLES A. GORDON



DR. RUDOLPH MATAS' BIRTHDAY VOLUME

CAN JOURNAL OF SURGERY will be devoted to a collection of papers written in honor of Dr. Rudolph Matas' seventieth birthday. This will make a volume of over 400 pages. The following committee has the matter in charge: Isidore Cohn, M.D., Chairman and Treasurer;

C. C. Bass, M.D., Henry Bayon, M.D., Henry Daspit, M.D., E. D. Fenner, M.D., I. M. Gage, M.D., H. B. Gessner, M.D., C. J. Landfried, M.D., F. A. Larue, M.D., I. I. Lemann, M.D., R. C. Lynch, M.D., Urban Maes, M.D., Henry E. Menage, M.D., A. L. Metz, M.D., C. Jeff Miller, M.D., Alton Ochsner, M.D.

After the October issue of The American Journal of Surgery has appeared these articles will be republished in book form. The edition will number 1000. Four hundred of these will be autographed by Doctor Matas and sold by the Committee at \$15.00 a volume. The remainder will be offered at \$10.00 a copy, by the publishers.

Many of America's leading surgeons have contributed to this volume. The names of contributors are synonymous with modern surgery. There will be contributions from the pen of J. C. Bloodgood, Robert C. Coffey, George W. Crile, John B. Deaver, J. M. T. Finney, Senior and Junior, Evarts Graham, Frederick L. Hoffman, J. Shelton Horsley, Rene Leriche of Strasbourg, Howard Lilienthal, William J. Mayo, Paul Moure of Paris, Joaquin

Trias-Pujol of Barcelona, Mont R. Reid, E. Ribasy Ribas of Barcelona, Hubert A. Royster, and D. P. D. Wilkie of Edinburgh. The titles cover a wide field in the domain of surgery.

In this issue, the usual features appearing monthly in The American Journal of Surgery will be omitted.

Doctor Matas, now Emeritus Professor of Surgery at Tulane School of Medicine, is one of the giants of American Surgery. His contributions to surgical technique, research, and literature have been many and important. Therefore, now that he has reached the autumn of his life, it is eminently fitting that his professional friends and colleagues make this gesture in his honor.

T. S. W.



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JOHN OSBORN POLAK

⊕ JOHN OSBORN POLAK ⊕

March 12, 1870—June 19, 1931

Monday morning, June 29, 1931.

When most of his staff had left the city over a sweltering week-end he remained at his desk to finish a paper that had been promised. This was characteristic, he worked year in and year out, his

OHN Osborn Polak died suddenly

day starting at six in the morning and ending near midnight.

In his death America lost one of its illustrious obstetricians and gynecologists. Both specialities were enriched because of his ceaseless labors. He strove constantly to better the standards of medical education and practice. He was particularly interested in young men and throughout the country are scores of men he trained. Many of his "boys" are making solid reputations in their chosen field.

He contributed voluminously to the literature. Essentially the clinician, text-books, monographs and journal articles bore his name as author. He religiously attended meetings of local medical socie-

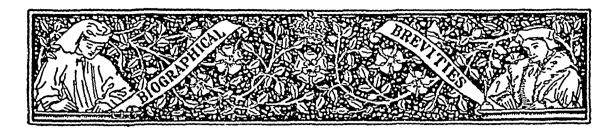
ties, and meetings held throughout the country whenever it was possible for him to get away from his large practice.

High honors were bestowed upon him at home and abroad.

Doctor Polak was a member of the editorial board of The American Journal of Surgery and gave much of his valuable time to his duties. He was generous in making suggestions, offering constructive criticism, and in going out of his way to make a promise into a reality. It was his habit to do a thing well or not do it at all. The publisher and editor will miss his presence, his inspiration and kindly offices.

Conspicious in this country and abroad, simple in his tastes, temperate, considerate of others, his friends were legion. As has been said of all men of distinction, he passed on too soon. But to those who admired and held him in great affection, his name will be inscribed on the tablet reserved for "the loved and lovable whose names live evermore."

T. S. W.



"SIMS" POSITION"

TAMES MARION SIMS, one of the gynecological pioneers in America, was born in Lancaster District, South

Carolina, January 25, 1813.

Sims was given the degree of Bachelor of Arts at the College of South Carolina in 1832. He started the study of medicine in the office of Dr. B. C. Jones, a practitioner of Lancaster, South Carolina. He began his first lectures at the Medical College of Charleston, South Carolina, in 1834. He graduated from Jefferson Medical College, Philadelphia, in 1835.

For eighteen years he engaged in general practice in Alabama. At a time in life when most physicians would have thought they were permanently settled he was attacked with a diarrhea. Inasmuch as this type of diarrhea was fatal to those who remained residents of the South, Sims began to wander from place to place. Having a growing family and being in want of funds he settled in New York City at Madison Avenue and 29th Street. This was in 1853. His residence was out in the "sticks" as at that time there was no first-class dwelling north of 23rd Street.

Within a short time recognition came and he was a busy man. He founded the State Hospital for Women in 1855 (New York City). In 1868 he was made Governor and Senior Consulting Surgeon of The Woman's Hospital (New York City). During the Franco-Prussian war he was Surgeon-in-Chief of the Anglo-American Ambulance Corps. Dr. Sims was president of the American Medical Association in 1876 and of The American Gynecological Society in 1880.

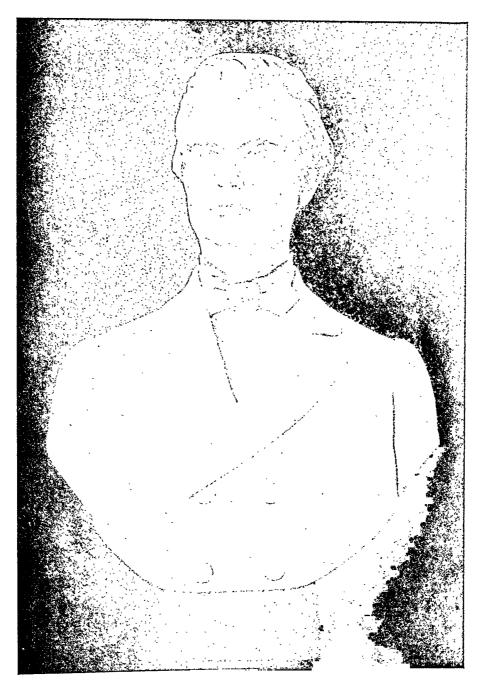
His first contribution to medical literature was an article on Trismus Nascentum which appeared in the American Journal of Medical Sciences in 1846. His epochmaking papers had to do with Silver Sutures in Surgery (1849) and Vesicovaginal Fistula (1852).

His surgical treatment of vesicovaginal fistula gave him world renown. Until his technique was perfected this condition as a result of child-bearing had little chance of being cured. Sims' operation revolutionized the handling of these cases and proved a boon to womankind.

While practicing in Alabama Sims, by chance, discovered that air entered the vagina when a woman is examined in the knee-chest position. In time he changed his method of examining the woman to that of lying on her left side (Sims' position). He reserved the knee-chest position for special examinations or treatments.

Sims enjoyed one of the largest practices of his time in New York City. His first patient was referred to him by Dr. Valentine Mott. The patient had a vesicovaginal fistula. It has been written that he was "a kind hearted but impulsive man." He was one of America's most gifted surgeons and his name will be a permanent one in medical history.

He died, in his seventieth year, on November 13, 1883.



J. MARION SIMS
[1813-1883]





[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

SURGERY AMONG THE NORTH AMERICAN INDIANS*

ERIC STONE, M.D., F.A.C.S.

PROVIDENCE, R. I.

TF questioned about the medical practices of the American Indians most physicians would exceed their knowledge by murmuring something about bizarre ceremonies, incantations and mumbojumbo. These certainly were phases of American medicine but a study of the subject reveals a surprising amount of realistic treatment for those conditions with which the Indian was familiar. The Indians' total inability to grapple with the problem of epidemic infection, their terror and the absurdities to which they resorted created the popular opinion a hundred years ago that Indian medicine was non-existent. Only recently are archeologists and ethnologists bringing to light not only the pageantry but also the rationality of aboriginal medical practices. The picturesque ceremonies were used either as a psychotherapeutic adjunct to legitimate therapeutics or were employed in the face of grave disorders, usually those in the realm of internal medicine, where the pathological process was beyond the reach of their diagnostic powers. The Indians' crowning achievements, medically, lay in the field of surgery; especially if we consider surgery to include the care of wounds, fractures and

dislocations. This is not remarkable as it was just such disturbances to which they were most subject as the chase and warfare were important elements in their life.

While the average Indian knew infinitely more anatomy than the average white man the Indian medicine-man knew much less than his European brother. But it was not the lack of anatomical knowledge which limited to a marked degree the general surgery of the Indian. Nor was it the ignorance of theories of sepsis and antisepsis for the invaders were just as ignorant. The ultimate reason for retardation of surgical development lay in the dependence of the Indian on implements provided in the natural state by their environment. All their tools for any occupation consisted of stone, shell, horn, wood, bone, reeds or grasses and animal parts. The development of surgery to an unappreciated extent was due to the development of tools, especially those with cutting edges. The keenest cutting edges the Indian could produce were those made by abrasion and grinding of flint chips. This set a definite limit to the possibilities of their surgery. This, I believe, was even more important than the absence of the inductive method of thinking.1,18

^{*} Submitted for publication Aug. 10, 1931.

The Indians' material culture was that of the Stone Age, in curious contrast to their high artistic and ideational development. They lacked forceps, hemostats, indeed all essential surgical implements. However, with their crude instruments, the flint, the thorn and sinew, the cautery of glowing coals, sticks and thongs they achieved noteworthy results.

During the three centuries of contact with the invaders the Indians assimilated but little of the foreign culture, that little consisted in borrowing or stealing the white man's weapons of offence. Indeed as one reviews the relations of the two races there was little in the contact which would invite the Indian to covet or admire the other's culture. At present the European culture is being shoved down the throats of the resistant remnants; but even today in many phases of life they cling to their traditions. Although there are a relatively large number of Indians practicing orthodox medicine in the United States at present, some 600 having been graduated from recognized schools of medicine, the majority of medicine-men are practicing precisely as did their archetype of 300 years ago.

În pre-Columbian days certain tribes of the Southwest, under the influence of the advanced Mexican and Central American civilizations, practiced trephining. The indications for the operation were probably not those of today for as far as can be learned the procedure was carried out on those possessed by evil spirits and the object of the decompression was to allow these spirits to escape. But that practically the procedure was good therapeutics in some cases was not to be doubted as many persons suffering from intercranial pressure present symptoms which would have appeared to the Indians to denote demoniacal possession. The degree of bone repair found in many trephined skulls indicates that there was a relatively high survival rate. It is further known that those who survived the operation were considered sacred and became part

of the priesthood. But this art had disappeared by the time of the Spanish conquests and nothing is known of the technique or of the instruments used in the operation.¹³

Perhaps the most interesting operation performed on the continent at the time of its discovery was the incision and drainage of the chest in cases of empyema. This was not infrequently carried out by the Indians of the Great Lakes area as they were peculiarly subject to lung affections. The ribs were not resected; but very decent drainage and a high percentage of cures were attained by this method of treatment at a time when it was seldom or never employed in European practice.¹⁵

For the rest of the more formal phases of surgery little can be said. All Indians could amputate digits; but not arms or legs. Boils and abscesses were opened, and drained by wicks of shredded bark or reeds. The indications for phlebotomy were understood and the operation was widely used. 10,13,18

The North Carolina Indians were the only ones who understood the use of the ligature. This knowledge permitted an interesting operation which they employed on their slaves. To prevent the unfortunate prisoners' escape they mutilated their victims' feet. An incision was made along the dorsum of the foot at the base of the toes and carried back to the head of the metatarsal bones at which point amputation was completed. Bleeding vessels were tied with ligatures of sinew (an improvement over the thread or wire ligature in vogue at the time in Europe). The skin flap was rolled down over the exposed joint surfaces and restored by sinew threads to the sole. This was quite an operation especially from the point of view of the slave as the instruments consisted of scalpels of sharpened flint and needles made of thorns. 18

A more modern instance is interesting in that it demonstrates the Indians' knowledge of hypnotics and presents surgery as it had been practiced by them throughout the ages. In 1902 Naiuchi, a famous Zuni medicine man of the old school, opened a breast abscess. The patient

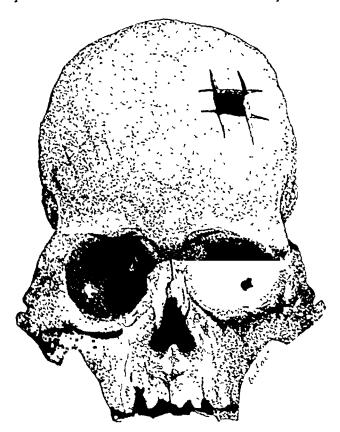


Fig. 1. Trephined skull.11

was given a bowl of infusion of jimson-weed (Datura stramonium) to drink and in a few minutes seemed to be in a deep and peaceful sleep. The abscess was widely incised with a fragment of flint and as the operator broke up the loculi with his unwashed and ungloved finger a large amount of pus was evacuated. Yucca wicks were placed and the wound dressed with a ground squash seed poultice. During the entire procedure the patient slept soundly, making no move, not even a grimace.¹⁷

In the treatment of wounds the Indians were on familiar ground and might justly be proud of their work in this field. The principles which guided them bespeak keen observation and a clear understanding of the problems involved. They understood the importance of debridement, immobilization, drainage, wound suture, the difference between healing by first intention and that after suppuration and

in the presence of the latter knew the efficacy of cure by granulation in a widely open wound.^{7,10,14}

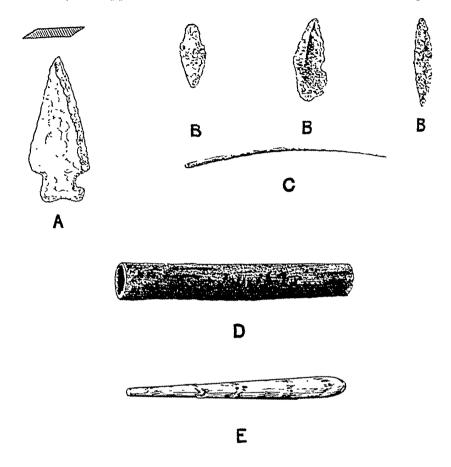
The Tuscarora, Dakota and Winnebago Indians sutured larger wounds with sinew threaded on bone needles, removing the suture in from six to eight days. They insisted that their wounds should heal from the bottom, which they accomplished when using sutures by placing a thin membrane of bark between the cut surfaces before placing their stitches. Some Indians, notably the Mescalero-Apache, used twists of fiber or cloth as wicks for drainage. Most tribes contented themselves by removing only the more superficial foreign bodies or comminuted bone fragments; but the Tuscarora showed a skill in debridement and the removal of even deep seated arrowheads or shot that would have been creditable in 1918.7,10,11

They dressed their wounds daily and used as medicaments only those things which promoted drainage or by osmotic action caused external flow of serum and other fluids. Until the wound healed they never applied salves which tend to seal the wound. They used washes, powders, poultices and packs; a few of their applications we know actually had antiseptic properties and others were stimuli for granulating tissue.^{7,10,14}

The use of nicotine was extensive, tobacco being chewed and tamped in the wound as a plug or ground and dusted into it. Nicotine is widely antiseptic and draws fluid from raw surfaces. In 1912 a friend of mine took a canoe trip with an Indian guide. One day when bathing he tore his right thigh from just above the knee to within 2 in. of Scarpa's triangle and to a depth sufficient to expose the saphenous vessels. The guide daily packed this wound with tobacco and the wound healed by first intention and in two weeks was functioning freely. A month later the wound was a fine hairline of scar.

Another widespread practice, especially in compound fractures, was an almost constant irrigation of the wound with cold water. The New England tribes used the turpentine boiled from the wood of white pine in a similar way, or applied the bark,

gum tree. Dandelion greens were ground fine and powdered on wounds and the whole leaf laid on as a top dressing. The



& Stone, 31

Fig. 2. A. Flint knife. B. Phlebotomy flints and scarifiers. C. Bone needle. B. Bone tube for ritualistic sucking and blowing powders on wounds. E. Tamponer of carbonate of lime.

beaten to a pulp, as a poultice. They also used the bark of the alder as a poultice, and decoctions of the bark of sarsaparilla or infusions of hellebore were applied as wet dressings. Scrapings of the root of the water-lily were placed on granulating wounds to speed all regeneration. In the middle Atlantic area kerosene, which they skimmed from marshes, was used as wet dressings. In the Southwest hot poultices of crushed watermelon or squash seeds were common. The Southern Indians made wet dressings of decoctions of the root of pennywort, sometimes mixing with it an antiseptic and astringent gum obtained by boiling the root of the sweet Indians of the Great Lakes region and the Missouri River made tents or poultices of the barks of slippery elm or common elder. A growth from the bark of the wild rose was scraped off, charred and powdered on open wounds. In short the Indian not only knew what effects he desired of his treatment but had discovered what local herbs would bring about these results.^{2,6,8,11}

As described previously, one tribe at least knew the use of the ligature in controlling hemorrhage in wounds. Most of the tribes understood the use of the cautery to stop bleeding and used live coals or burning brands for this purpose. For oozing the Mescalero for instance packed

the wound with eagle's down. The Haidah used spiders' webbs and the Missouri River Indians employed puff balls, all acting as effective coagulants. Where smooth sumach was indigenous its hemostatic property was well known. All tribes could apply the tourniquet.*

This sounds like relatively modern medicine and becomes even more impressive when compared with the practices of contemporaneous whites. The Indians were carrying out these rational procedures in the care of wounds even as far back as the time when European doctors were despairing of the use of the cautery and boiling oil and had swung to such extremes as the puppy fat dressings of Paré and the "weapon salve" which Paracelsus was endeavoring to repopularize.6

That the Indians had peculiar success with wounds is abundantly attested by a host of witnesses as all observers, medical and military, noted the beautiful results of the aborigines' methods of treatment as compared with those of the whites. Indians seemed to have recovered from injuries which would have been fatal to a white man. At a time when gunshot wounds of the bladder were invariably fatal to the pioneer these injuries were well borne by the Indians. Loskiel examined a man whose face had been torn in a fracas with a bear, the limbs lacerated, the rib cage crushed, and the abdomen disemboweled. The man had crawled four miles to his village and in six months had completely recovered, except for hideous scarring. Bourke reports the cases of two severely wounded Indians who had been discharged from a military hospital, in extremis, that they might die among their people. But a month later it was found that they had completely recovered under the care of their own medicine-men. Such records could be continued indefinitely as white men were so impressed by the ability of the Indian to survive terrific wounds that hundreds of cases have been described.5,16

The Indians were as familiar with fractures and dislocations as they were with wounds, and were just as successful in their treatment. The knowledge was not confined to the medicine-man for the lay Indian was almost as adept as his professional brother. As a result it was rare to find a deformity after a fracture.

In most tribes broken bones were immediately set and splints applied. The splints were usually made of slats, lengths of sapling or stout reeds cut long enough to immobilize neighboring joints. Near their two ends the slats were fastened to one another by running thongs in such a way that when applied they were about 2 in. apart. When such an arrangement was put in place it gave very efficient support, could be easily readjusted and gave ample space for the application of soothing lotions or poultices or for the treatment of the wounds in compound fractures.3,12,13,18

Some of the tribes devised very perfect splints. The Shoshone made a cast of raw hide saturated till pliable with water. This was moulded about the limb after the reduction of the fracture. When dried they resulted in a rigid cast as perfect as any now produced by plaster of Paris. The Winnebago and Dakota hit on the same device, except that they employed sheets of bark. In both types windows were cut where wounds existed. 2,6,15

After union the limbs were skillfully massaged, exposed to the sun or treated with heated stones, and passive and active motion used to restore function.

In regard to dislocations their treatment was equally good. A few of the tribes did not understand the reduction of the hip; but all knew how to reduce dislocated shoulders or digits. The Ottawa and Chippewa realized the importance of muscular relaxation, and having noted the relaxation of the muscles in the presence of nausea, brought this on by administering emetics before attempting reduction. Loskiel happened on a lone hunter just after he had reduced a dislocation of the hip. The Indian had strapped the foot of his

^{*}References 2, 7, 10, 14, 18.

injured leg to a tree and then pushed himself away from it using his arms and uninjured leg and with appropriate rotations of his pelvis had snapped the head of the femur into place.9,16

The really remarkable recoveries from wounds and injuries may not have been entirely due to skillful case management. The Indian may have developed biological aids through centuries of exposure to such accidents which militated against shock, hemorrhage and suppuration; just as the civilized man had developed a relative racial immunity to many infectious diseases. One immediately thinks of the possibilities of more effective adrenal activity or some such other endocrine adaptation. Furthermore each patient was treated separately in his own lodge or tepee and so was not subject to hospital gangrene which in the 18th and 10th centuries wrought so much havoc among the soldiers who were being wounded in the same way, at the same time.

But given these advantages on the one hand and the limitation of his physical equipment on the other, it must be conceded that the American, even at the time of his discovery, had brought certain phases of the art of surgery to a remarkable degree of perfection.

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BOOK REVIEWS

DEEP X-RAY THERAPY IN MALIGNANT DISEASE. By Walter M. Levitt, M.B., D.M.R.E., Medical Officer in Charge of the Radiotherapeutic Research Department. Being a report of an investigation carried out from 1924 to 1929 under the direction of the St. Bartholomew's Hospital Research Committee. London, John Murray, 1931.

For nearly a third of a century physicians have been treating malignant disease by means of the x-rays, alone or in conjunction with radium, surgery and other measures. Owing to the constant revision of ideas of dosage and penetration of rays, up to date (with perhaps a few exceptions) we have not had available the results of any definite group of patients treated by modern x-ray therapy alone and followed through under adequate expert supervision from both the clinical and the technical standpoint. Such a group study under ideal conditions has been presented in the report of an investigation carried on from 1924 to 1929 under the direction of the St. Bartholomew's Hospital Research Committee, the deep x-ray therapy having been given in the Radiotherapeutic Research Department of this hospital under the supervision of Mr. W. M. Levitt.

The techniques employed have been discussed in some detail; also the experimental and theoretical considerations from which these techniques have been built up. In recording the results the author has very carefully brought to light the debit side of the account as well as the good results; and he has made an estimate of the discomforts and the dangers associated with the treatment. Very few accidents have occurred.

The cases treated were limited to malignant disease, as follows: (1) breast, (2) uterus, (3) upper air passages, (4) esophagus, (5) rectum, (6) thyroid gland. The term "malignant disease" was defined to include any new growth which was proved on microscopical examination to be a malignant tumor, even though the type of the malignant disease could not be classified into any of the known groups. Microscopical examination was carried out in all cases, with the exception of a few where such a removal would be considered unjustifiable,

as, for example, in advanced carcinoma of the esophagus. In only 30 of the 327 cases treated was there failure to obtain a biopsy. Radiographic studies of the lungs and mediastinum were carried out in all cases of carcinoma of the breast or upper air passages with enlarged supraclavicular glands, in all cases of carcinoma of the esophagus and in all cases of sarcoma in whatever situation. The one case of chorioepithelioma also underwent these radiographic studies.

The apparatus employed delivered a pulsating secondary current with a peak voltage corresponding to 42 cm., or about 230,000 volts. Changes were made in the apparatus later, so that it delivered 4 ma. of a practically constant high tension current at a parallel spark gap of 38 cm., later increased to 196,000 volts. The filtration was 0.5 mm. of zinc until July, 1926, after which time it was increased to 1.5 mm. of copper. This latter filter was chosen as being the heaviest which could be used without prolonging the duration of the exposure to a degree which was excessive from the point of view of the comfort of the patient. Owing to the comparatively satisfactory results obtained in the upper air passages and uterus groups with the heavy filter, this filter was retained for these cases from its adoption to the end of the research. In the breast and rectum groups a return was made to the lower filtration, that is, to 0.5 mm. of zinc. The highly radiosensitive small round-celled sarcomata, in whatever group, were invariably treated with the lower filtration.

The book goes into great detail in regard to apparatus and treatment and the management of the case during and after treatment. The results are discussed group by group.

There were 4 cases of the 327 treated in which death could have been attributed to the x-ray treatment: (1) A case of melanotic sarcoma of the vulva, where a condition resembling acute cellulitis appeared in the region which had been irradiated by the intensive single dose method, and gradually extended very widely, the patient dying of profound toxemia eleven days after treatment. (2) A case of carcinoma of the thyroid gland where the growth had fungated into the trachea. The patient died of respiratory obstruction about a fortnight after treatment. (3) A patient with a post-cricoid growth

was reported to have died suddenly at home about a fortnight after the treatment. No details were obtained. (4) A patient treated for an extrinsic carcinoma of the larynx developed erysipelas of the scrotum from which he died. It is quite possible that the disturbance of the blood picture and especially of the leucocyte elements may have contributed to the fatal result. Thus, in 3 of the 4 cases, or in less than 1 per cent of the total number of cases treated, death may have been due to a direct x-ray injury; and in these three the connection is neither very clear nor convincing.

There were no cases of electrical shock, either to the patients or to the personnel. Aside from the case of melanotic sarcoma already referred to, there was only one case in which a serious x-ray burn was produced. This was a case of carcinoma of the breast, in which following a full dose of x-ray, radium was applied also with full dosage. In some cases the erythema reactions produced were rather more intense than anticipated, and in a few cases desiccation resulted. In all of these, however, healing was complete within two or three weeks after the appearance of the erythema.

Tracheotomy was performed as a preliminary treatment in all cases of malignancy in the upper air passage group in which the glottis was sufficiently narrow to render the reactionary swelling dangerous. In only one case, however, was the tracheotomy necessary as an emergency method.

In the uterus group there were a few cases of irritation of the bladder and the lower bowel with diarrhea. In no case, however, was severe cystitis or proctitis observed.

Up to the present there have been no cases of late necrosis. In certain instances in the upper air passages group a perichondritis of the laryngeal cartilages was noted after an interval of several months. In one case an acute perichondritis occurred without warning-after complete freedom of eighteen months from all evidences of laryngeal disease. This patient recovered. The mode of action is probably by interference with the nutrition of the laryngeal cartilages in such a way as to render them more liable to the occurrence of bacterial inflammation. The recognition of perichondritis as an x-ray effect is important, since the condition is likely to be mistaken for recurrence of the growth and further x-ray treatment given.

In the section dealing with results, it was

seen that of 319 cases included in the statistics. 48, or 15 per cent, are now without evidence of the disease. There are, however, 271 patients who have either died of the disease or are alive with signs of the disease present. In 03 of these 271 cases no appreciable improvement followed. Therefore, in about 20 per cent of all cases it may be said that the x-rays proved of no value whatever. In the remaining 178 cases of the group of 271, the treatment resulted in varying degrees of palliation. In 24 per cent of the total group, the patients were improved sufficiently to return to ordinary work for a time. In 10 per cent of the total group, or 31 cases, there was a lesser degree of improvement, but there was marked relief of the prominent symptom or symptoms. In 22 per cent, or 69 cases, only minor degrees of improvement were observed, lasting a few weeks only. In the patients who were sufficiently improved to be able to resume their ordinary avocations, improvement varied in duration from a few months to over three years, averaging about one year.

The net result of all the treatments, therefore, in this group was that of 319 cases included in the statistics, out of a total of 327 cases treated, 48 are free from evidence of growth at present; 109 showed a marked degree of palliation; 69 showed lesser degree of palliation, and 93 showed no appreciable improvement following the treatment.

At the conclusion of the work the author, speaking for himself and for the very dependable members of his consultant committee, felt that the following statements were justifiable:

"(1). Malignant growths, even when at an advanced stage, may be made to disappear by x-ray treatment, and the patients may remain free from all evidences of the disease for long periods—upwards of four years, and perhaps permanently.

"(2). The proportion of cases in which these results may be obtained varies in different situations of the disease, being greater in the upper air passages, uterus and breast groups, than in the rectum and esophagus groups.

"(3). In a large proportion of cases in which complete disappearance of the disease is not effected, marked reduction in the size of the growths and great or even complete alleviation of symptoms lasting from months to years may result. Many of these patients are enabled to return to their ordinary work during the greater part of this period.

Book Reviews

"(4). The risks involved in the treatment are very small, and the discomfort to the patient almost negligible.

"(5). In certain cases a combination of x-ray with radium is probably superior to the use of either of these methods of treatment alone."

James T. Case.

THE INFANT WELFARE MOVEMENT IN THE EIGHTEENTH CENTURY. By Ernest Caulfield, M.S., M.D. With a Foreword by George F. Still. N. Y., Paul B. Hoeber, Inc., 1931, 223 pp.

The history of pediatrics so long neglected seems at last to be coming into its own and there is now a growing list of books on the subject but as yet not long enough to prevent a new one from being an event for those interested. The latest addition is a truly charming series of essays on the welfare movement in the eighteenth century, that interesting period which saw so many beginnings grow out of its healthy scepticism. Almost everyone thinks that infant welfare is a new thing when it really goes back into the dim past and in the eighteenth century there was a remarkable impetus given to it by the deplorable conditions that obtained at that time until one wonders in reading about it if these people were really civilized after all.

Causield's book naturally centers about the big four of the eighteenth century movement in England: Thomas Coram, William Cadogan, Jonas Hanway and George Armstrong. All giants and very human and interesting giants. By his magic touch the author has resurrected them and made them and their age live again for us. It is a book which ought to be on the shelves of everyone interested in the history of medicine.

Thomson and Miles' Manual of Surgery. By Alexander Miles, M.D., LL.D., F.R.C.S. and D. P. D. Wilkie, M.D., F.R.C.S. Humphrey Milford, Oxford Univ. Press, 1931, Ed. 8, Vol. 1, 574 pp.

A new edition of "Thomson and Miles" is always welcome. Dr. D. P. D. Wilkie has succeeded Dr. Thomson as co-author with Dr. Miles.

The first volume has been brought up-to-date by these two authors in a very satisfactory manner. The handy size of this volume $(7\frac{1}{2})$

5) is to be heartily recommended in these days of limited shelf room. So much knowledge has been crowded into 600 small pages that one readily forgives the lack of quality in the illustrations which are not quite on a par with those in other (and more expensive) volumes.

PROCTOSCOPIC EXAMINATION AND THE TREATMENT OF HEMORRHOIDS AND ANAL PRURITUS. By Louis A. Buie, M.D., F.A.C.S. Phila., W. B. Saunders Co., 1931, 178 pp.

A practical book on the treatment of hemorrhoids from an authoritative source has long been lacking and this book covers the subject in exactly the manner the general practitioner needs.

Dr. Buie has covered the ground thoroughly and completely and the simplified illustrations leave nothing to be desired.

The reviewer is thoroughly in accord with Dr. William J. Mayo who says in his foreword: "There is need for better work in proctology, by the surgeon, the internist and the general practitioner. Of these three members of the profession, the general practitioner stands in the position to do the most good. The time when he first sees the patient is the most favorable time to avert lurking tragedy by accurate diagnosis and opportune treatment. This little book is offered as a manual of consulting-room diagnosis of diseases of the anus and rectum and of the treatment of hemorrhoids. It is practical and sound."

INJURIES AND SPORT, A GENERAL GUIDE FOR THE PRACTITIONER. By C. B. Heald, M.D., M.R.C.P. Humphrey Milford, Oxford Univ. Press, 1931, 543 pp.

A special book on the injuries received in sport might seem at first to be unnecessary. Even an occasional glance at the contents, however, will show that there is a very definite place in the library of every physician for a book of this kind. It tells concisely what to do and how to do it so that it may be referred to in times of emergency. Medical men in colleges and schools and those at summer resorts will find this book particularly valuable.

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION FOR 1930. Vol. XXII. Edited by Mrs. Maud H. Mellish-Wilson, Richard M. Hewitt, M.D., and

Mildred A. Felker, B.S. Phila., W. B. Saunders Co., 1931, 1125 pp.

The famous Mayo papers reached their maturity with the publication of the twenty-first volume last year. Volume XXII, now before us, is an indication that this series is entering upon its adult years, full of strength and ambition, and gives every evidence of continuing the healthy virility of its youthful years.

The remarkable range of activities of this outstanding clinic is nowhere better symbolized than in this annual volume.

Of the 482 papers emanating from this clinic in 1930, 85 are reprinted in full, 30 are abridged, 55 are abstracted and of 312 only the titles are given. Despite this careful editing, we have a volume of over eleven hundred pages. It would be interesting to have all the Mayo papers printed in book form and indexed. No doubt, they would form the best possible record of the progress of surgery at this time.

Breast-feeding. By Margaret Emslie, M.B., CH.B. London, Humphrey Milford, Oxford Univ. Press, 1931, 142 pp.

As the author says in her Preface, "Breast-feeding is a function of which there should be little to learn in the year 1931, yet never probably has breast-feeding given so little cause for satisfaction as in this time." Dr. Emslie has covered the subject in a concise fashion and for the pediatrician this book will be a handy work of reference.

THE PAPYRUS EBERS. Translated from the German version by Cyril P. Bryan, M.B., B.CH., B.A.O. With an introduction by Prof. G. Elliot Smith. N. Y., D. Appleton & Co., 1931, 167 pp.

Prof. G. Elliot Smith states in his Introduction: "The Papyrus, although written about 1500 B.C., is really a collection of bits and pieces of folk-lore, much of it five and some of it probably twenty centuries older. It is expressed in archaic phraseology, so that many of the terms relating to the diseases and drugs are impossible to identify. In the face of these insuperable difficulties, it is not surprising that most scholars have refrained from risking their reputation for scholarship by pretending to translate a technical document in which many of the technical terms are at present untranslatable.

"An heroic attempt to provide a translation in

German was made, however, many years ago by Dr. H. Joachim. This attempt naturally provoked many criticisms, especially from those scholars who had the philological knowledge to recognize the solecisms. But if the time is not yet ripe for an adequate translation, the Papyrus is so interesting that no excuse should be necessary for providing a rendering in English of the only version at present available for those who cannot read the scripts of Ancient Egypt. Hence Dr. Cyril Bryan is to be commended for giving us in English an interpretation based upon Dr. Joachim's translation, though not slavishly following it."

Both Dr. Bryan and the publishers are to be congratulated upon making this book available to English-speaking readers. It makes a splendid companion to the more ambitious translation of the Edwin Smith Papyrus recently published in this country.

DIAGNOSIS IN JOINT DISEASE, A CLINICAL AND PATHOLOGICAL STUDY OF ARTHRITIS. By Nathaniel Allison, M.D., F.A.C.S. and Ralph K. Ghormley, M.D. N. Y., William Wood & Co., 1931, 196 pp.

The authors have devoted six years to what they term the "complete study" of arthritis. In this time, they have obtained records in 289 cases, concerning themselves chiefly with a systematic presentation of the clinical facts and pathological variations of the cases. The authors have attempted to point out methods of diagnosis and classification that will simplify the process for the average medical man.

Beautifully produced and illustrated, it is unfortunate to see the title page marred by two misprints.

PRACTICAL X-RAY TREATMENT. By Arthur W. Erskine, M.D. Saint Paul, Bruce Publishing Co., 1931, 112 pp.

In less than 120 pages the author has set down those methods of treatment which he has used himself, expressing in each instance his reasons for selecting them. No attempt has been made to include all the methods used. This work, therefore, is a splendid starting point for the beginner in roentgen therapy and offers great advantage over the larger works which often confuse rather than assist a beginner. On the other hand, after studying this book the reader will be well prepared to seek further details in other volumes.

PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

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PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

CHAPTER XIV

THROMBOPHLEBITIS

Postoperative thrombophlebitis occurs as one of the late complications of operative procedures. It makes its presence known usually during the second or early third postoperative week.

According to many observers the development of the condition is insidious in that close observation during the earlier period of convalescence will frequently reveal an elevated pulse rate (Mahler¹), an elevated temperature (Michaelis^{2,3} Petrén,⁴ Hampton and Wharton,⁵ or both an elevated pulse rate and an elevated temperature, the source of which is not evident at the time.

I. INCIDENCE

Thrombophlebitis is found as a complication of all types of operations, and the development of sepsis in wounds does not seem to act as a predisposing cause; most cases seem to develop in connection with so-called "clean" surgical procedures. Postoperative thrombophlebitis may occur in any vein in the body and after operations even so slight as the extraction of a tooth, the removal of a cataract, the removal of tonsils, or the performance of submucous resection of the septum nasi.

The frequency of occurrence of thrombophlebitis following abdominal operations has been variously estimated at between 1 and 4 per cent, the majority of observers favoring a lower rather than a higher figure within these limits, and almost all being agreed that this complication follows pelvic surgery more frequently than surgery of the upper portion of the abdomen.

Beckman⁶ reported 16 cases in 5835 operations performed at the Mayo Clinic. Clark⁷ found 35 cases in 3000 operations. Hampton and Wharton⁵ reported 205 cases in 21,000 gynecological operations performed in the Johns Hopkins Hospital Clinic. Klein⁸ found 70 cases in 5851 operations, Bondy⁹ 13 cases in 1000 gynecological operations, Ranzi¹⁰ 1.2 per cent of cases in a series of 6071 operations.

As previously stated, any vein in the body may be the seat of postoperative thrombophlebitis. When, however, the process involves the deeper veins the diagnosis is usually difficult and indeed often impossible during life, whereas, conversely, the more superficial the veins involved in the process the more readily is the condition recognized. For this reason thrombophlebitis of the femoral and saphenous veins can frequently be diagnosed in the recent state, but cavernous sinus thrombosis and thrombosis of other deep veins and blood sinuses though possibly not suspected during life may not infrequently be found post mortem if specifically sought. Since thrombophlebitis of the lower extremitis is, therefore, the variety commonly diagnosed and also, as a matter of fact, the only type for which methods of treatment have been devised, the present discussion is perforce concerned almost exclusively with thrombophlebitis of the lower extremities.

II. ETIOLOGY

Presumably at least two general factors are concerned in the production of thrombophlebitis: (1) injury to the endothelial lining of the blood vessels, and (2) retardation of the flow of blood through the lumen of the vessels. The exact manner in which these two changes are produced is largely a matter of debate at the present time.

In spite of much speculation on the subject little of actual importance has been added to, or subtracted from, the original conception of Aschoff.¹¹ He considers that the fundamental process is slowing and eddying of the blood in the veins of the thigh, particularly in the upper part of the femoral Book Page 544

vein and the pelvic plexus. As a result of this action blood platelets are sifted out of the blood stream and are deposited on the walls of the veins particularly in the region of the valves. As they collect some interaction occurs between the platelets and the intima of the blood vessel whereby they become adherent, the one to the other, and initiate the formation of a white clot. As the coagulum increases in size it tends to block the lumen of the vessel more and more completely; ultimately flow of blood through the vessel ceases, and red blood clot forms until it obliterates the vein progressively to the point of entrance of the next afferent tributary.

For a most complete and thorough consideration of the various physiological, biochemical, and theoretical considerations of the subject the reader is referred to the monograph presented by Ritter before the International Society of Surgery, Warsaw, July, 1929.

Certain investigators have suggested sepsis as an important factor, interpreting the relatively considerable period of time between the performance of an operation and the development of symptoms of thrombophlebitis as the incubation period of the infectious organism, but there is little evidence to support such a view. Lubarsch studied 215 cases of thrombophlebitis bacteriologically and was able to demonstrate organisms in but 20 instances.¹²

Possibly the source of the trauma to the walls of the vessels may be different in different cases, sometimes (a) mechanical, sometimes (b) toxic, and sometimes (c) bacterial.

Most clinicians believe that the enforcement of a prolonged period of recumbency in bed predisposes to the development of the condition by generalized or localized slowing of the circulation. Such a theory is thought to elucidate the mechanism of occurrence of thrombophlebitis in the lower limbs especially, and also to account in some part at least for the interesting clinical fact that thrombophlebitis of the left leg is of the order of nine times as frequent as thrombophlebitis of the right leg. Localized slowing of the circulation in the lower extremities is supposed to be produced as follows:

- 1. Poupart's ligament compresses the femoral vein against the horizontal ramus of the pubic bone.
- 2. From this point to the inferior vena cava venous blood has to flow against gravity.
- 3. The right common iliac artery (or occasionally the abdominal aorta) compresses the left common iliac vein against the spine.
- 4. The sigmoid flexure of the colon, which often is filled with inspissated fecal material, is more apt to interfere with the circulation in the left common iliac vein than with that of the right common iliac vein.

Bachman and Bizzaro¹³ believe that thrombophlebitis may be anticipated as a complication in all conditions in which the number of platelets per cubic millimeter of blood is much increased. These authors regard 750,000 platelets per cubic millimeter as the upper limit beyond which such a complication may be expected to occur. Thrombophlebitis occurs with a fair degree of frequency in many non-surgical conditions, chlorosis, gout, influenza, rheumatism, pneumonia, typhoid, and typhus. Presumably the mechanism of production is not dissimilar in the surgical and non-surgical cases.

Chauvin, Esmenard, and Jaur¹⁴ have shown in a series of 25 cases that there is usually a slight but insignificant increase in the coagulation time following operative procedures and that gynecological operations, which are more prone to be followed by phlebitis than other varieties, show this particularly; the blood coagulation time, however, in 8 cases in which phlebitis had already developed, showed slightly shortened but constant coagulation time.

Various other factors proposed as predisposing causes of thrombophlebitis are:

- 1. Heart derangements (Albunus¹⁵)
- 2. Pressure of tumors on veins (Albunus¹⁵)
- 3. Handling of blood vessels while the abdomen is open (Albunus¹⁵)
- 4. The effect of narcosis on the heart (Albunus¹⁵)
- 5. Bandage pressure (Albunus¹⁵)
- 6. Rough handling of retractors (Clark⁷)

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- 7. Necrosis in stumps distal to ligatures (McLean¹⁶)
- 8. Transfixion of vascular areas by ligature (McCann¹⁷)
- 9. Varicose veins (Bartlett¹⁸)

III. Symptomatology

Subjectively patients developing postoperative thrombophlebitis usually complain of localized deep soreness which is present during rest but is aggravated during motion and is described as a dull, burning ache. In some cases there is actual acute pain, which in exceptional instances may be severe enough to require the use of morphine for its relief. The most important single sign of the condition is tenderness along the course of the affected veins, and the diagnosis may not be made in the absence of this (Fig. 55).

Edema is important when present; it occurs in about 50 per cent of cases. In the case of post-partem thrombophlebitis of the lower extremity Homans¹⁹ believes that the white swelling which often develops and which he very aptly describes as "porky" edema results from interference with the lymphatic drainage of the part. Such an occurrence should not be surprising, considering the intimate association between the deep veins and the lymph vessels, the latter occasionally being actually embedded in the adventitia of the walls of the veins. This intimate relationship is particularly seen in the groin and along the iliac veins, since in this area the entire lymph drainage of the lower extremity courses in very close proximity to the large veins. An inflammatory reaction in the veins could hardly fail to produce a similar reaction in the lymphatics. In cases which do not present edema presumably the superficial vessels alone are involved (i.e., usually the short and long saphenous veins), the presence of adequate collateral venous circulation preventing venous stasis, and the lymphatics, which course for the most part deep to these vessels, not being involved.

Systemic reactions are noted in nearly nine-tenths of the cases; the temperature characteristically rises to 100.5F. or so within twenty-four hours after the onset of the pain; the pulse

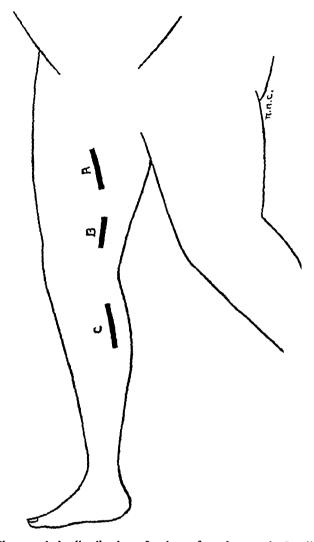


Fig. 55. Characteristic distribution of points of tenderness, in 87 clinical cases of postoperative thrombophlebitis of the lower extremity according to Brown. The region of the calf of the leg designated as "c" showed tenderness in 64 per cent of the cases. In 9 per cent of the cases all three regions, "A," "B," and "c" showed tenderness. In 27 per cent of the cases tenderness was confined to the regions indicated by "A" and "B." Left leg was involved in 64 per cent of cases, right leg in 16 per cent of cases, and both legs in 20 per cent of cases.

¹ Brown, G. E. Postoperative phlebitis. Arch. Surg., 15: 245, 1927.

rate in most cases does not exceed 100 beats to the minute. The duration of the systemic reaction averages 3.5 days in cases uncomplicated by pulmonary infarction, in which latter case, however, it may last as long as three weeks or occasionally even much longer.

Cyanosis of the affected part and localized redness do not ordinarily form a part of the clinical picture, though these signs may occasionally appear. It must be appreciated also that thrombosis of even a large superficial vein may occasionally produce no local signs or symptoms whatever.

IV. TREATMENT

The prophylactic treatment of this complication, so far as prophylactic treatment can be outlined in the absence of a better understanding of the fundamental pathology concerned, centers mainly about the prevention of stagnation of blood in the lower extremities. It has been suggested that all postoperative patients, insofar as practicable, be kept in a moderate Trendelenburg position during their postoperative stay in bed and that in the later convalescent period either passive massage of the lower limbs or active movements, as recommended by Pool,²⁰ in the manner of "bicycle riding" exercises be instituted.

Nurses and attendants should, however, be warned of the danger of massaging or otherwise manipulating "sore" or "painful" legs developing in postoperative cases, except in accordance with specific instructions from competent medical attendants.

In 1927 Walters²¹ suggested the use of thyroid extract as a prophylactic measure against the development of postoperative thrombosis and embolism. It was argued that the judicious use of this therapeutic agent by increasing the metabolic rate should increase peristalsis, the depth of respiratory movements, and the general rate of flow of blood through the veins. The dose advocated was two grains administered thrice daily

by mouth, beginning on the third or fourth postoperative day and continuing for seven days or until the patient was sufficiently convalescent to be allowed out of bed. In a series of 1745 cases subjected to major surgical procedures at the Mayo Clinic, Walters adopted the regime and no patient less than seventy years of age died as a result of pulmonary embolism. There were however, 2 patients, both over seventy years of age, in whom unsuspected and coincidental pulmonary embolism was found at autopsy, the patient having died of other causes.

Freund,²² in Germany, obtained results comparable with those of Walters. In a series of 2000 cases of patients over thirty-five years of age, which had been subjected to laparotomy, prostatectomy, or hernioplasty, and had been treated postoperatively with thyroid extract, only 2 cases of fatal embolism occurred.

This proposed use of thyroid extract, though apparently so far successful in a relatively considerable number of cases at the Mayo Clinic and also in Germany, needs to be subjected to more extensive trial, especially by surgeons in other localities and under all variations of surgical practice before its true value can be accurately determined, and it should be especially remarked that the ultimate standard by which its efficacy must be judged is its ability to prevent not only fatal embolism but also nonfatal thrombophlebitis and thrombotic infarcts. In this connection it cannot be too strongly emphasized that in surgical practice cases of embolism frequently occur in groups. A relatively long interval of time may elapse during which no cases occur, and suddenly, for no apparent reason 2 or more cases may be seen in rather rapid succession, whereupon another relatively long period of freedom from embolism occurs.

There is danger of falsely ascribing prophylactic value to any measure which might be applied during a period in which no case of thrombosis or embolism would naturally occur. Thus Popper saw 4 cases of fatal pulmonary embolism in January 1929, no other cases for six months, and then 2 more fatal cases during the last week in July 1929. Any prophylactic measure which might have been applied during the six months from the last of January to the last week of July in Popper's clinic might have been given credit for a favorable result for which it would have deserved no credit at all.

Although the rationale of Walters' use of thyroid extract seems well founded and certainly any attempt to attack the problem of the prophylaxis of postoperative thrombosis and embolism is very welcome in view of the well-nigh helpless position with respect to this complication in which the surgeon has found himself hitherto, some evidence has already been presented which should serve as a warning to the overzealous therapeutic enthusiast.

In the first place, a carefully controlled investigation by Popper²³ has apparently failed to substantiate the value of both synthetic and natural thyroxin in the prophylaxis of thrombophlebitis and its complications. In the first series of cases there were 150 control cases and 150 cases treated by the oral administration of synthetic thyroxin. In the 150 treated cases there occurred I fatal case of pulmonary embolism, I case of thrombophlebitis complicated by infarcts, and 2 cases of bilateral thrombophlebitis. In the control series occurred no cases of fatal embolism, no cases of infarction, but 4 cases of thrombophlebitis. Because Popper suspected that the synthetic thyroxin used in this series might be less efficacious than natural thyroxin derived from animals, he used a "natural" preparation "thyropurin" in a second series of cases. In this series there were 50 control cases and 50 cases subjected to "thyropurin" therapy. In the control cases there developed I fatal case of pulmonary embolism associated with symptomless thrombosis of the right femoral vein and I case of thrombophlebitis of the right leg. In the treated cases there occurred I case of bilateral thrombophlebitis of the legs and I case of thrombophlebitis of the left leg in a patient "who made an unexpected recovery." The doses used in the two series of

experiments were synthetic thyroxin, 1 mg. thrice daily, and "thyropurin," 1 mg. (2 tablets), thrice daily. Both preparations were given orally.

In the second place, the routine administration of any drug as potent as thyroid extract is generally speaking a highly undesirable procedure. Therefore, one wonders whether the end quite justifies the means in connection with thrombophlebitis. The incidence of postoperative thrombophlebitis is, as previously noted, relatively low, and the percentage of patients who die of embolism following thrombophlebitis'is much lower still. Nevertheless, in order to save the very occasional case it is proposed to subject the entire postoperative group to the action of a drug which is very potent and which is capable of causing untoward symptoms in certain cases and possibly permanent organic damage in some. As a matter of fact not all patients submitted to major operative procedures can take the recommended doses of thyroid extract at all. The most skillful surgeon can doubtless recognize many such cases at the start and in all cases will be on the alert to discontinue the medication if indications arise after the administration of the drug has been undertaken, but there is certainly a danger that the less skillful surgeon may not be in so favorable a position to do this and therein lies what seems to be a real danger which should not be lightly dismissed.

Popper found that synthetic thyroxin caused no untoward symptoms at all but concluded that it was also of no value. "Thyropurin," on the other hand, caused tachycardia, severe cardiac arrhythmia, or motor restlessness in 12 per cent of the cases.

The conservative treatment of thrombophlebitis consists in wrapping the involved part carefully in cotton wool to relieve pain and to avoid the dislodgment of parts of the thrombus as emboli into the circulation and in elevation of the part. The local application of cold over the involved area, as by the use of ice-bags, is grateful to the patient, but may be harmful in that it tends to produce local vasoconstriction, a process at variance with the presumably beneficent vasodilatation provided by nature in the presence of inflammation. It is believed that the use of heat is much more rational, and



Fig. 56.

Figs. 56, 57, 58, 59, and 60. The various steps in the application of an Unna's paste boot. The paste itself is composed of four parts each of zinc oxide and sheet or flake gelatin, and ten parts each of glycerin and water. The gelatin and water are placed in the inner compartment of a double boiler and allowed to stand over night; in the morning the mixture is heated over the water bath formed by the outer compartment of the double boiler; as soon as the gelatin has become thoroughly liquefied the glycerin is added and the zinc oxide is stirred into the mixture very gradually. The finished paste is of the consistency of thick cream or thin batter when hot, but sets into a tough rubbery or elastic mass on cooling. If too thick a small amount of water may be added to the paste before use; the paste may be liquefied and allowed to set a number of times if for any reason the entire amount initially prepared is not used at the first sitting.

Fig. 56. Method of elevating limb for relief of blood stasis and edema preparatory to application of boot. Limb is maintained in elevated position for at least five minutes.

heat is often quite as welcome to the patient as cold. From a practical point of view application of heat may perhaps best be effected by the erection of a light-tent or heat-tent over the affected part. The cotton wool wrappings previously applied should be voluminous in order to provide mild immobiliza-

tion of the diseased member, and since this type of dressing tends in itself to prevent heat dissipation a very considerable degree of heat can easily be maintained by the method outlined.



Fig. 57. Position of limb during application of boot. Thigh is flexed on abdomen to a right angle, leg is flexed on thigh to a right angle, and foot is dorsiflexed on the leg to a right angle or even somewhat more than a right angle. This position is of the utmost importance in the application of a snugly fitting, comfortable, and efficient boot. Note that the first step in actual application of boot has been taken, a couple of layers of loose meshed gauze bandage have been rolled at the base of the toes and just below the knee.

In the cases unaccompanied by much fever and local tenderness mild active exercises of the leg may be begun within a week or ten days after the inflammatory process has begun to show improvement, since in such cases the clot is presumably not very friable and, accordingly, there may be anticipated little danger from embolism. On the other hand, in those cases in which the inflammatory reaction has been more intense the infection has presumably produced a more friable clot, and elevation of the part should be continued until there is no longer generalized fever or localized tenderness.

With regard to the operative treatment of thrombophlebitis it is probably best to treat the deep iliac variety conservatively, providing the patient is not clearly suffering from

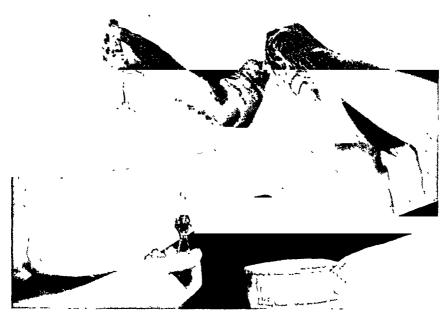


Fig. 58. Unna's paste is being painted on the leg and foot with ordinary paint brushes; note the inner compartment of double boiler from which the paste is being taken. Note also that paste is not being applied over edges of gauze at base of toes and bend of knee, but stops at some distance from these edges.

septicemia and repeated pulmonary infarction. In such cases an attempt should be made to tie the iliac vein or even the inferior vena cava central to the thrombotic process.

In thrombosis of the superficial veins of the leg ligation of the saphenous system above a process of septic thrombosis is rational, and probably indicated, provided a streptococcal cellulitis of the part be not threatening.

On getting up from bed patients should keep the affected limb in an elevated position most of the time for several days, but gradually the length of periods of dependence of the part may be increased in accordance with the swelling ensuing thereupon. A complicating pulmonary infarction can be diagnosed in about 33 per cent of cases of thrombophlebitis, the fever continuing in these cases for an average of five days, but is only



Fig. 59. Alternate layers of loose meshed gauze roller bandage and Unna's paste are being applied to build the boot up to the desired thickness. Note that the roller bandage is cut straight across at those places in which reversed turns would otherwise be required; this is done in order to keep the boot quite smooth and comfortable. The boot completely covers the heel.

slightly higher than in other cases; usually the signs and symptoms of infarction follow the onset of phlebitis by about four days.

Hampton and Wharton⁵ report the incidence of pulmonary infarction in their series at 7 per cent; 1.5 per cent developed pulmonary embolism. Patients, who in the convalescent period exhibit marked edema of the extremities, when allowed to be up and about after complicating thrombophlebitis, often may be made comfortable and a valuable therapeutic measure may be invoked by the application of a well-fitted Unna's paste boot to the part (Fig. 60). The boot is made by applying alternate

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layers of Unna's paste and loose-meshed roller bandage over the affected limb from the base of the toes to just below the knee. The Unna's paste is applied by means of an ordinary



Fig. 60. Boot completed. Last layer is one of Unna's paste, and when this layer has almost set it is dusted with talcum powder. Note support given to this leg which like uncovered extremity is site of extensive varicose veins.

wide paint brush and should be of the consistency of thick cream or thin "batter." The paste constituting the first layer is applied directly to the skin. Over this are applied two or three layers of loose-meshed roller bandage, the bandage being cut directly across instead of folded at points where "reverse" turns would otherwise be necessary. Over the gauze a second coating of Unna's paste is applied, and over this two or three more layers of gauze. The last layer of Unna's paste is applied over this and the entire boot is allowed to "set" in the open air. It is, of course, essential that the application of such boots should be made with the limb well elevated and drained of edematous fluid and blood. The Unna's paste boot need be changed only when it becomes soiled or loose.

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CHAPTER XV MISCELLANEOUS POSTOPERATIVE COMPLICATIONS

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CHAPTER XV

MISCELLANEOUS POSTOPERATIVE COMPLICATIONS

I. Postoperative Hernia

A. ETIOLOGY: Doubtless there are certain cases in which by virtue of organic disease, underdeveloped musculature, unavoidable infection of abdominal incisions, and the like, postoperative incisional herniation cannot be avoided, but it is probably true as a general rule that such an occurrence not secondary to preexisting peritonitis is a direct reflection on the judgment and ability of the attending surgeon and his assistants. Postoperative hernias occur most frequently as a result of (1) wound infection, (2) improper use of drains, (3) faulty and careless apposition of anatomical layers, especially the fascial planes, (4) the use of coarse suture material, strangulation of considerable portions of tissue by ligatures in the process of controlling hemorrhage, and large, improperly tied knots, (5) the improper use of stay, or relaxation, sutures, (6) careless use of hemostats with consequent devitalization of tissue and subsequent sloughing of the devitalized tissue in the wound, (7) improper incisions, (8) postoperative straining and vomiting, and (9) postoperative distension and urinary retention.

Masson¹ reporting statistics from the Mayo Clinic for the five-year period from 1915 to 1920 states that 2 per cent of 28,970 abdominal operations were for postoperative hernia. Southam² reports a similar percentage from the Manchester Royal Infirmary. Nassau³ states that 0.3 per cent of all patients subjected to operative procedures involving extensive and prolonged drainage develop postoperative hernia. Masson¹ found that 33.8 per cent of all postoperative hernias occurred through low midline incisions.

B. Prophylaxis: Obviously the prophylaxis of this condition falls more properly within the province of a treatise on operative technique than one on preoperative and postoperative treatment, but recognition of the etiology of the condition is important in that it stimulates added caution in the postoperative treatment of cases in which the operative technique is known to have been imperfect.

II. POSTOPERATIVE WOUND RUPTURE

A. DEFINITION AND DIAGNOSIS: Wound rupture is a condition which is occasionally encountered. It occurs late in the postoperative period, usually from the seventh to the twelfth postoperative day, and often without premonitory signs, i.e., in the absence of infection and drainage. Commonly, however, the wound is seen to exude a watery blood-tinged material, and frequently the general condition of the patient is poor. For this reason wound rupture should always be suspected in those cases in which there is a profuse serosanguinous discharge from the abdominal wound and the patient is vomiting and otherwise convalescing unsatisfactorily.

In wound rupture all the layers of the wound give way widely, or in some cases all layers below the skin; intestinal loops may escape in the latter case through the deeper layers of the abdominal wall and come to lie just below the skin; adhesions between them and the abdominal incision may become so firm as to cause kinking and obstruction. The latter condition results so frequently that all patients with postoperative vomiting in whom obstruction is suspected should be investigated from the point of view of wound separation. Probing of the wound will usually make clear the condition of affairs in case the skin has closed, and without probing clarification of the etiology of the vomiting is usually impossible, for the skin is sometimes apparently well healed and exhibits neither redness, swelling, nor secretion from the wound margins. In the usual case, however, the diagnosis is sufficiently obvious because local bulging can characteristił

cally be seen in the region of the operative incision, and this bulging is increased on coughing and straining.

B. ETIOLOGY: Among the various causes of wound rupture have been mentioned (1) unusual strains, (2) infection, (3) debilitation and anemia, (4) serous effusions and hematomata in the wound, (5) increased acidity due to systemic intoxication, and (6) protrusions of omentum through improperly or imperfectly closed tissue planes.

Most of these factors may be partly or wholly responsible for wound rupture in certain cases, but there are rather cogent reasons why certain of them cannot be considered as accounting for any considerable number of instances. If unusual strains were a frequent cause of wound rupture, the condition might well be expected to occur with a far greater degree of frequency than it does, because even though "unusual strains" be construed rather narrowly such strains occur far more frequently than wound rupture. Infections almost certainly account for very few cases of true wound rupture; of course, as is well known, infections of laparotomy wounds do cause disintegration of a greater or smaller amount of tissue, but even when an open sinus develops between the peritoneal cavity and the exterior surface of the abdomen, the wound usually ceases to break down as soon as drainage has become adequate, and in true wound rupture there is characteristically no such tendency; furthermore, cultures of material taken from cases of wound rupture are characteristically relatively sterile. Against the etiological importance of debility and anemia can be urged the fact that when wounds which have undergone rupture are subsequently closed by surgical means they usually undergo prompt and satisfactory healing; it is, however, clinically true that wound rupture occurs with a relative degree of frequency in connection with carinoma in which cachexia is a prominent finding. Hematomas or evidences of preexisting hematomas are rarely found in cases of wound rupture, but Lahey4 suggests that the cause for wound rupture may frequently be found in failure to obliterate the dead space between the edges of muscles in cases in which a muscle-splitting incision has been used; a consequent accumulation of serous exudate results, and this hinders the process of repair.

The hypothesis of increased acidity which has been championed by Weber⁵ is purely a hypothesis, and, furthermore, if it is to be accepted some explanation must be offered for the ease with which healing is stimulated subsequently by secondary suture. Freeman's⁶ hypothesis is very ingenious and may account for many of the cases. According to his theory some hiatus in the suture-line serves to initiate the process; through this hiatus a small piece of the omentum finds its way; constriction of this portion of omentum occurs at the suture-line, and edema of the entering wedge of tissue ensues; this edema still further separates the wound edges, and more omentum follows; the process is repeated again and again until the whole wound breaks down.

c. Treatment: The treatment of cases of wound rupture consists in reopening the incision, separating any adhesions which may have formed between the walls of the incision, omentum, and intestinal loops, gentle replacement of the eviscerated organs and secondary suture of the abdominal wall.

Theoretically secondary suture should be performed carefully layer by layer just as in the case of the primary closure, and in a certain percentage of cases such a procedure may be entirely feasible. In many or most cases, however, secondary tissue changes have occurred to such an extent that tissue planes can be recognized only with difficulty, if at all, and the surgeon should in such cases feel quite content if he can replace the contents of the abdomen and appose the sides of the wound by "through and through" sutures including the entire thickness of the abdominal wall. Such sutures should consist of non-absorbable material, such as silk, linen, or silkworm gut, and should not be drawn too tightly. In the most difficult cases advantage should be taken of the Mikulicz type of drain, the wound being left open. Secondary closure of the wound is usually best performed under local infiltration anesthesia,

the straining incident to the administration of a general anesthesia being inadvisable for obvious reasons. As a rule following such treatment healing takes place kindly and without the occurrence of postoperative herniation.

III. PAROTITIS

- A. HISTORICAL. According to Charlton⁷ postoperative parotitis was first described by Munde⁸ in 1878. As early as 1886 Paget⁹ was able to collect 101 cases, half of which occurred in connection with operations on the female genitalia and the other half in connection with various other intra-abdominal operations. In 1889 Hanau¹⁰ originally propounded the theory that postoperative parotitis occurs by extension of infection from the mouth by way of Stenson's duct.
- B. CLINICAL CLASSIFICATION. Cases occur (1) of acute primary inflammation of the entire gland, and (2) showing symptoms of recurrent duct obstruction.
- c. ETIOLOGY. It is generally accepted at the present time that most of the cases of postoperative parotitis result from an ascending infection of Stenson's duct. Probably some cases represent metastatic foci from a blood-borne infection, and possibly some cases occur as a result of lymphatic extension.

The fundamental predisposing cause seems to be dryness of the mouth. Thus in a series of 1000 cases of gastric ulcer treated medically there was an incidence of 4.5 per cent of parotitis in 450 cases treated by oral starvation, whereas there was an incidence of only 0.4 per cent of parotitis in a series of 530 cases in which food was allowed by mouth (Charlton⁷).

In addition to dryness of the mouth the structure or character of the gland must also be a predisposing cause, since whereas infection of the parotid gland is not an infrequent complication, inflammation of the other salivary glands, submaxillary and sublingual, occurs but rarely. Lynn¹¹ explains this on the basis of the fact that the parotid gland is essentially a serous gland whereas the submaxillary and sublingual glands are essentially mucous glands, and according to Stuart Low¹²

mucin has an inhibitory effect on the growth of bacteria. Charlton⁷ calls attention to the fact that the parotid gland also contains lymph nodes, whereas the other salivary glands do not, and believes that the presence of these nodes favors the spread of infection.

Although no evidence has ever been presented directly to substantiate the hematogenous origin of postoperative parotitis, Buscarlet and Kaiser¹³ abroad and Jennings¹⁴ and Fisher¹⁵ in this country believe that the condition arises as a metastasis from purulent foci elsewhere in the body. Against such a theory are the following two rather cogent arguments: (1) Positive blood cultures cannot usually be obtained in cases developing postoperative parotitis, and (2) operative procedures which pursue an entirely aseptic course may be complicated by parotitis.

Charlton⁷ does not believe that trauma to the parotid gland by pressure of the anesthetist's finger during the course of the administration of an anesthetic as emphasized by some authors is of any importance as an etiological factor, inasmuch as in his experience the complication is as apt to occur after spinal and local analgesia as after general inhalation anesthesia.

D. AGE AND SEX INCIDENCE. According to Charlton⁷ post-operative parotitis accurs more frequently in adults than in children, more frequently after the third decade of life than before, and more frequently in females than in males; also he states that the condition is particularly likely to occur during the months from November to April, i.e., the time of the year during which respiratory infections are most prevalent. About one-quarter of the cases are bilateral, three-quarters unilateral.

In a series of 6100 cases of coeliotomy reported by Collins, there were 8 instances of parotitis, an incidence of 0.13 per cent; one of the cases occurred, however, previous to operation rather than afterward.

In a series of 2716 cases in which major operative procedures had been performed Charlton⁷ found 13 cases of post-operative parotitis, an incidence of 0.47 per cent.

- E. Bacteriology. The infectious organism most commonly recovered from cases of postoperative parotitis is the staphylococcus. The pneumococcus, streptotoccus, and bacillus coli are occasionally recovered, and the order in which they have just been named is presumably the order of importance. Hellendale¹⁷ has reported one case in which the gonoccocus was recovered from the parotid gland.
- F. CLINICAL PICTURE. Most frequently postoperative parotitis occurs within from two to ten days after the operative procedure; occasionally the time interval is considerably longer as in one case reported by Fowler¹⁸ in which the symptoms developed only after eighteen days. The first symptom is elevation of the patient's temperature, sometimes as high as 104° or 105°, and corresponding increase in the pulse rate. At the same time there develops severe pain in the region of the parotid gland and swelling of the tissues in the parotid region. The severity of the pain is probably to be attributed to the architecture of the gland: inasmuch as the gland is traversed by many strong fibrous connective tissue septa which permit of little distention of the gland substance. For this reason also, extension from one lobe of the gland to the adjacent lobes may be quite slow, although eventually the entire gland may become actively involved.

Sometimes the condition pursues a relatively benign course; the local pain is moderate, the swelling slight and localized strictly to the region of the gland. In other cases the condition may become alarming, due to the development of symptoms of profound sepsis, the patient developing a spreading edema of the neck, face, and head accompanied by high fever, chills, and intense local pain.

The range of temperature is from 99° F. in the mild cases to 105° F. in the severe cases, and the pulse rate varies pari passu between 110 and 130. The leucocyte count usually ranges between 10,000 and 25,000.

The differential diagnosis is usually not difficult. Only in those cases in which there is some focus of infection in the immediate vicinity is there likely to be confusion. In such cases lymphadenitis and cellulitis must be differentiated.

- G. TREATMENT. Taking every factor in the etiology into consideration, the prophylactic treatment includes:
- (1) Preoperative attention to the oral hygiene of the patient,
- (2) Avoidance of trauma to the region during the administration of anesthetics,
- (3) Avoidance of postoperative dehydration of the oral cavity, and
- (4) Prophylactic chewing movements during the early portion of the postoperative period.

In the simpler non-virulent types of the disease spontaneous resolution may be expected to occur, and this may be hastened by the application of either hot fomentations or cold compresses over the involved area; equally good authority can probably be cited for both variants. When it is possible to open the patient's mouth sufficiently widely the medical attendant should seek to determine the patency or non-patency of Stenson's duct; this may be done either by manipulation of the gland to see whether saliva can be expressed from the duct or in doubtful case by probing the duct. If an obstruction is encountered or suspected a skiagram should be made to determine the presence or absence of a salivary calculus. If an obstruction can be demonstrated it must be overcome by surgical means; usually the opening of the duct requires to be split.

Operative intervention of a more radical nature is required (1) when the parotitis is fulminant from the start and (2) when an initially more benign type of the condition becomes progressively more malignant. In no case should incision and drainage be delayed for more than forty-eight hours because of the danger of extensive suppuration and even gangrene of the gland.

Obviously the precise indication for incision and drainage is suppuration but because of the firmness of the capsule of the

parotid gland it is usually by no means possible to be sure whether actual suppuration has or has not occurred, fluctuation being extremely difficult to elicit.

Lilienthal¹⁹ advises the use of a curvilinear incision starting just in front of the auricle of the ear and just as close to it as possible, extending the incision downward behind the angle of the jaw and then forward as far as the anterior border of the masseter muscle; this incision extends only through the skin; the flap thus formed is gently dissected forward so as to expose the greater part of the fat and fascia overlying the parotid gland. One incision or multiple incisions are then made through the parotid fascia into the substance of the gland itself; these incisions should radiate in the general direction of the fibers of the pes anserinus, and no incision should be made actually along the course of Stenson's duct. Deep collections of pus not thus directly accessible may be evacuated through the same cutaneous incision, by opening a tract through the fascia behind the angle of the jaw, subsequently enlarging the tract by Hilton's method.

The death rate in postoperative parotitis may be as high as 40 per cent, and is 5 to 10 per cent lower when only those cases which have been drained are considered. The relatively high mortality is not altogether due to the parotitis, because the general condition of the patient apart from this particular complication is frequently bad.

IV. POSTOPERATIVE HICCOUGH (SINGULTUS)

A. ETIOLOGY: The etiology of singultus in the postoperative case, as indeed in other cases, is still obscure in spite of the fact that this complication has been known and discussed from the earliest times. Even the manner of production of the spasmodic effort known as hiccough is not entirely settled, although it is generally believed that it represents a clonic contraction of the diaphragm; there is evidence for believing that occasionally only one-half of the diaphragm is involved in this spasm.

It is assumed that singultus occurs as the result of simulation of the respiratory center (a) directly by mechanical means, as the result of cerebral disturbances, (b) indirectly by toxins carried to the center by way of the blood stream, or (c) reflexly through the sensory fibers of the phrenic, vagus, and splanchnic nerves, as a result of peritoneal irritation. The latter mechanism is probably of relatively greater importance than the others, and it is assumed to account for by far the greater number of cases of postoperative singultus. It must be remembered, however, that singultus is frequently a symptom of some gravity in a host of conditions not connected with surgical procedures, tabes dorsalis, hydrocephalus, tuberculous meningitis, tuberculosis of the pons and cerebellum, to mention some of those possibly giving rise to direct stimulation of the respiratory center, and any condition in which toxemia is a prominent factor, such as the acute infectious diseases, may give rise to toxic circulatory stimulation.

Hiccough follows operations on the biliary tract with more frequency than other operative procedures; possibly this fact is explained by the proximity of the invaded area to the lower surface of the diaphragm.

Singultus occurs much more frequently in men than in women, and an attempt has been made to explain this sex distribution on the basis of the abdominal type of breathing found in men.

Postoperative singultus usually subsides spontaneously and without giving much cause for anxiety. Occasionally, however, it becomes a most distressing complication and one which may sometimes so debilitate the patient as to cause an adverse shift in the prognosis. In every case in which treatment for singultus is required an attempt should first be made to locate the source of some possible reflex irritation.

B. TREATMENT: The frequency with which singultus ceases after the stomach has been washed out in certain cases and after drainage tubes have been removed, from the region of the common bile duct or from the stomach or an iliostomy in

other cases strongly suggests that the factor of mechanical irritation may frequently be a predominant one. In many cases, however, the search for the causa causans is unproductive and in these cases, the cause of the singultus not being discoverable, the treatment must be largely symptomatic. Many general means have been devised for the relief of this condition, the very multiplicity of the proposed measure being a good indication that no one of them is uniformly successful. In addition to the use of various household remedies these include:

- 1. Physical measures
 - a. Application of a tight abdominal binder
 - b. Forced flexion of the thighs on the abdomen
 - c. Passage of the esophageal sound
 - d. Repeated gastric lavage with quantities of warm sodium bicarbonate solution
 - e. Stimulation of vomiting
 - f. Holding the breath
 - g. Massage
 - h. Drinking water while holding the breath

2. Drugs

- a. Administration of one drop of tincture of iodine in a teaspoonful of water every fifteen minutes for six doses
- b. Cocaine per os or per hypodermic
- c. Morphine per os or per hypodermic
- d. Chloral hydrate
- e. Bromides
- f. Barbital derivatives
- g. Epinephrine
- h. Luminal
- i. Chloroform anesthesia
- j. Active cathartics
- k. Active emetics

Carbon dioxide inhalations are perhaps as frequently successful as any type of treatment. In persistent hiccough

inhalation of a mixture of 90 per cent oxygen and 10 per cent carbon dioxide will almost invariably relieve the diaphragmatic spasm within twenty minutes; the effect may be permanent, or a relapse of symptoms may occur within an hour or so. The rationale of the procedure is not altogether clear, but in effect regular, rapid, and powerful contractions of the diaphragm are substituted for irregular and spasmodic ones, i.e., the diaphragmatic rhythm is altered. In administering the treatment a regular anesthetic machine may be used or if this be not available a funnel or cone is simply attached to the outlet of a carbon dioxide tank and the latter is opened until there is a distinct smell of escaping gas; the patient is now allowed to take repeated inhalations from the funnel, soon after which the hiccough usually disappears. If singultus recurs the treatment is repeated as often as necessary.

In intractable cases operative attack on one or both phrenic nerves has become an accepted procedure.

The intimate relationship between the phrenic nerve and hiccough must have been appreciated for many years, for according to Weeks²⁰ as early as 1833 Shortt²¹ of Edinburgh advised that in cases of intractable hiccough one should produce blisters over the origin and course of the phrenic nerve in the neck; he reported several cases treated successfully in this manner.

Grognot²² in 1885 and Leloir²³ in 1892 recommended the use of digital pressure over the phrenic nerve in the neck, and this device has some advocates at the present time. Capriati²⁴ in 1898 and Regis and Debedat²⁵ in 1897 recommended the application of galvanic and faradic currents of electricity to the region of the phrenic nerve in the neck for the same purpose.

As a result of the demonstration in 1911 by Stuertz²⁶ and Sauerbruch²⁷ of the possibility of paralysing the diaphragm by surgical sectioning of the phrenic nerves the foundation was laid for direct operative attacks on the phrenic nerve as subsequently practised. In ascending order of radicalism these Book Page 574

direct operative attacks include (1) injection of one or both phrenic nerves with novocaine; (2) freezing of one or both phrenic nerves with ethyl chloride; (3) monolateral or bilateral phrenico-phraxis; (4) monolateral or bilateral phrenicotomy, and (5) monolateral or bilateral phrenico-exairesis.

Amongst those authors who have reported successful results following the use of local anesthesia are Kroh²⁸ in 1917, Goetze²⁹ in 1920, Erkes³⁰ in 1921, Kummel,³¹ Payr, Ghose³² in 1926, and Jirasek.³³

Amongst those authors who have successfully used freezing methods are Kroh,³⁴ Kuttner,³⁵ Goetze,³⁶ and Dowman.³⁷

The more radical procedures have been performed in but relatively few instances: phrenico-phraxis by Weeks²⁰ in 1931, phrenicotomy by Kroh²⁸ in 1921 and 1922, Lehmann³⁸ in 1923, Oehler³⁹ in 1922, and Dowman³⁷ in 1927, and phrenico-exairesis by Kroh²⁸ in 1921, Kappis⁴⁰ in 1924 and Weeks²⁰ in 1931.

The disadvantage of novocaine injection is the shortness of the duration on the effect, three to eight hours in favorable cases; freezing of the nerves seems to produce a somewhat more prolonged effect, and phrenico-phraxis a still somewhat more prolonged effect.

Phrenicotomy produces a permanent paralysis, especially if a short portion of the nerve be excised to prevent the possibility of regeneration.

Phrenico-exairesis possesses the advantage over simple phrenicotomy that not only is the nerve trunk in the neck divided, but, if the proper technique is used, any tributaries which the phrenic nerve may receive further down in the thorax are also interrupted because they are torn away.

Bilateral paralysis of the diaphragm is a procedure which should not be invoked on slight provocation, but it is not at all inconsistent with life provided the accessory muscles of respiration are capable of performing their function in the normal manner and providing there is no gross intrathoracic disease such as to reduce markedly the vital capacity of the lungs. In treating intractable hiccough the suggestions of Weeks²⁰ seem to be eminently rational: "If all the usual methods of treatment fail, the patient should be fluoroscoped to determine which side of the diaphragm is involved. The phrenic nerve on the side involved should then be exposed under local anesthesia, and a stout silk ligature passed about it. The nerve can then be anesthetized. This effect apparently lasts about eight hours. Following this, traction should be tried, and if it fails the nerve can be easily exposed and crushed. If at the time of operation, novocaine block and traction both fail, it should lead one to believe that there is nerve anastomosis below the site of section or blocking, and the nerve should then be avulsed. If both sides of the diaphragm are involved, then both phrenics should be exposed and blocked either temporarily or permanently."

V. POSTOPERATIVE HEAT STROKE

Postoperative heat stroke is a rare complication of surgical procedures; at least, since the first description of the condition by Gibson⁴¹ in 1900 only very few cases have been reported. Gibson himself reported 2 definite cases and a third probable one. In discussing Gibson's report, Brewer⁴² reported an additional case, and Johnson⁴³ reported 3 cases. Crandon and Ehrenfried⁴⁴ in 1912 added 3 cases, Moschowitz⁴⁵ in 1916 added 5 more, Botteselle⁴⁶ in 1923 described 7 cases confirmed at autopsy, and Martin⁴⁷ in 1928 completed the list with 4 cases.

A. ETIOLOGY, SIGNS, AND SYMPTOMS: The designation "heat stroke" indicates the essential etiology as heat, but inasmuch as excessive heat produces several somewhat different disease syndromes, the differentiating features between this variety of heat effect and others like "sunstroke" and "heat prostration" must be somewhat more closely drawn.

Sunstroke, as the term indicates, develops as a result of direct exposure of a patient to the sun's rays; the onset of the

condition is abrupt with complete loss of consciousness, heat, dryness, and flushing of the skin, a pulse of high tension, and a very high general body temperature. Heat prostration, on the other hand, occurs in persons who are exposed to extremes of heat within doors, often artificial heat, and is particularly likely to supervene when persons work in confined and poorly ventilated rooms; the onset of this condition is gradual rather than abrupt, consciousness is usually not lost, the skin is pale, cold, and clammy, the pulse weak and thready, and the temperature subnormal, normal, or somewhat elevated, though it rarely exceeds 100°F.

Postoperative heat stroke conforms to neither of these clinical pictures exactly. It characteristically develops in patients who have been protected from the direct rays of the sun for a number of days. Little is known about the exact mode of onset, for the condition ensues so closely upon the operation in most cases that it is well nigh impossible to say just where the operative and anesthetic effect leaves off and the condition of heat stroke begins. However, the one diagnostic characteristic of the condition is the development of hyperpyrexia, ensuing within a very few hours after operation and characteristically reaching from 105° to 109°F. The skin has been described as hot and dry in most cases. The condition and character of the pulse cannot safely be assumed to be of any particular significance so closely following an operative procedure. Mentally the patients have usually been described as delirious or irrational. Heat stroke thus appears clinically to resemble sunstroke in most particulars, although direct exposure to the sun is not the exciting cause, and the patients are not completely unconscious.

Cases have been reported from Boston, New York, and Rome (Botteselle). They have occurred during what is commonly called a "heat wave," by which is meant a period of long continued high temperature with a maximum of atmospheric humidity and a lack of breeze. It has been assumed that the development of heat stroke is favored by too

closely covering patients with heavy blankets, by the unwise application of hot water bottles, by dehydration, and by inadequate ventilation.

B. TREATMENT: The treatment of the condition is fundamentally prophylactic and involves avoidance of operations of election during particularly warm and humid weather, and in case operations are necessary at such times the avoidance of needless swathing of patients in thick blankets, the prodigal use of hot water bottles, and failure to supply adequate ventilation.

In the developed case the treatment is merely symptomatic. The indication is for reduction of temperature, and in reducing the temperature reliance should be placed not upon drugs but upon physical measures. An ice cap should be applied to the head, sponge baths of cold water should be applied to the body, ice water enemata and gastric lavage with ice water may also be given. The ice pack as given to patients who develop postoperative thyroid storms should prove very valuable.

VI. CHRONIC MALARIA AS A POSTOPERATIVE COMPLICATION Chronic malaria as a possible postoperative complication is probably not sufficiently well recognized. In cases developing this complication sometimes no malarial history can be obtained preoperatively, though characteristically such a history can almost always be elicited if the attempt be specifically made. The complication manifests itself usually after five or six days of uncomplicated recovery, occasionally after a much longer period. It is initiated by a rise of temperature which may, on the one hand, be gradual and insidious, or, on the other hand, abrupt, following a chill. Almost invariably wound healing is delayed, the wound edges becoming swollen and painful, a serosanguinous exudate issues therefrom, and the wound tends to break down and gape. The urine frequently shows numbers of red blood cells. Careful microscopical examination of the blood at this time shows the presence of plasmodia, although previous to the operation they may have been entirely absent.

The administration of quinine hydrochloride intravenously or the sulphate by mouth (20 to 30 grains daily for four days followed by 10 grains daily for thirty days) is specific. Quinine

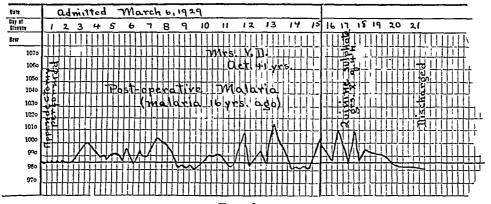


Fig. 61.

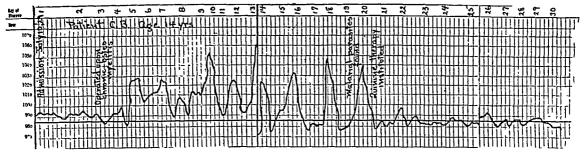


Fig. 62.

Figs. 61 and 62. Clinical charts of two patients who developed postoperative malaria on the surgical service of Dr. Alton Ochsner, Charity Hospital of Louisiana, New Orleans. The first patient had been subjected to the operation of appendectomy and developed characteristic symptoms only after ten days, although convalescence had previously been unsatisfactory; administration of quinine sulphate relieved complication completely within forty-eight hours. The second patient had been operated upon for chronic osteomyelitis and developed the typical symptomology of postoperative malaria at the end of six days, although the true nature of the condition was appreciated only after sixteen days at which time malarial plasmodia were sought and found in the blood; in this case malaria was not suspected at first because of septic nature of primary process. Quinine therapy relieved this patient immediately.

When specifically questioned both patients gave a definite history of preoperative malarial infection.

salts seem to act better if administered with a dilute acid, either dilute hydrochloric or sulphuric acids. Both constitutional and local conditions improve quickly under this therapy.

Because the complication yields rapidly and completely to the treatment outlined here, the danger lies not in inability to combat the condition once it has been recognized but rather in its recognition. (Slocumb⁴⁸)

VII. POSTOPERATIVE GAS BACILLUS INFECTION OF ABDOMINAL INCISIONS

Infection of abdominal wounds with gas bacilli is a very rare complication but one which has been reported and one which is very serious when it does occur. Butler⁴⁹ has reported 2 cases occurring in a series of 7000 laparotomies. Previously Beer⁵⁰ reported a case which occurred within forty-eight hours after appendectomy and, Ochsner and Schmidt⁵¹ also reported a case following operation for a perforated appendix accompanied by abscess formation. All of these patients made good recoveries under appropriate treatment. Apparently the contamination is derived from the intestinal tract, and various observers have found the offending organisms, B. tetani, B. welchii, vibrion septique, B. edematiens, B. fallax, B. sporogenes, B. histolyticus, B. putrificus, in various parts of the intestinal tract of operative cases, including the appendix.

The condition may be suspected when a sudden increase in pulse rate is observed, with or without a rise in temperature, in cases in which a patient is not doing well after operation. The presence of a brownish, foul-smelling discharge from the wound with local edema and crepitation make the diagnosis presumptive, and positive bacterial smears or cultures clinch the matter.

The treatment consists of promptly made multiple incisions, the institution of free drainage, and the administration of adequate doses of antiperfringens or Bull serum. The prognosis depends largely upon the extent of the infection, the early recognition of the condition, and the institution of early and adequate drainage.

VIII. POSTOPERATIVE PSYCHOSES

The unexpected development of frank postoperative psychoses is frequently a reflection on the diagnostic acumen Book Page 580

of the medical attendant who previously performed the preoperative examination. Surgeons with a background of psychiatric training should be able in a considerable percentage of such cases to recognize minor mental aberrations and by careful history taking to reveal psychotic tendencies or previous psychotic states. Frequently that surgeon is wise who, when dealing with patients presenting definite eccentricities, requests a preoperative psychiatric consultation.

Not only is it important preoperatively to recognize the frank psychopathias, but feeble-mindedness and subnormal mentality in general are inconsistent with a patient's satisfactory cooperation in many cases. Much embarrassment may occasionally be saved if the mental status of the patient is appraised before some gross mishap occurs through assuming that the patient possesses more intelligence than he is really able to command.

The development of a postoperative psychosis is not an event of very frequent occurrence. In cases in which it does occur there is often either a hereditary taint, or else toxemia, exhaustion, or allied states are present as predisposing causes. The development of such a condition immediately following operation is considered as due to the anesthetic, i.e., as a toxic manifestation; following the operative procedure by several days the operative procedure itself is incriminated.

Females and males are affected in about equal proportions, and the incidence is slightly higher following operations on the genital organs. In the average case complete recovery may be expected within three months, though certain patients recover much more promptly, whereas a certain small percentage never recover. (Brown⁵²)

One type of psychosis which is particularly apt to occur in connection with operations upon the aged, particularly such operations as prostatectomy, is the condition known as "acute hallucinosis." Eastman and Kilman⁵³ have emphasized the fact that the aged person, like the child, is affected to an abnormal degree by slight changes in environment. The

elaborate display of new furnishings, the strange garb of attendants, and the type of community found in the modern hospital perturb the aged person inordinately. He longs for the presence of his friends, and often seeks even in his sleep for familiar faces and familiar objects. Seeking relief from distasteful ever present realities, he may take refuge in auditory and visual hallucinations. He may even develop low grade delusions of persecution, which result in distrust of his medical attendants and the nursing staff; this is sometimes carried to the point of a complete change of personality in which there occur only a few lucid moments during the course of the day. Probably the derangement belongs to the group of psychoses which are often termed "exhaustion psychoses," and the background for the development of this condition is found in exertion incident to the patient's attempted adjustment to unusual surroundings. This complication is not to be regarded too lightly since it often results in nutritional disturbances. It may result seriously or fatally in patients who initially are reduced in vitality.

The condition is occasionally of so serious moment that it becomes highly desirable to employ some form of immediate relief. Probably the best method of relieving the condition in cases in which such a procedure is feasible is to send the individual home in an ambulance, and thus reestablish the continuity of his life at the point at which it was broken by his entrance to the hospital. Occasionally minor degrees of acute hallucinosis may be combated by allowing the wife, or friends, to remain in virtually constant attendance at the patient's bedside.

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